THE TELEGRAPHIC JOURNAL AND

ELECTRICAL REVIEW.

VOL. XXVI. MAY 9, 1890. No. 650.

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THE BEGINNING OF THE END.

THE Mutual Telephone Company, Limited, which was announced lately as having been formed with a capital of £100,000, has now issued a prospectus inviting the public to subscribe for £45,000 in order to establish a telephonic exchange in Manchester. The directorate is of a local character, and the lines of the company are practically founded on those of the "Co-operative Telephones," to which we alluded in these columns in December last. The delay in producing the prospectus has undoubtedly been of considerable importance for time has shown the value of the objections which we pointed out at the time; and the new company comes out with less of the co-operative element, but with a largely increased idea of the costliness of a telephonic exchange system. We pointed out at the time that the estimates were ridiculously low, and the amended figures, although exhibiting an improvement, will, in all probability, be found still to err on the wrong side.

The new company makes a distinct departure in one special point—to which we gave particular prominence—the substitution of a metallic circuit in their system for that of the earth-return; indeed, so much reliance is placed upon this method of working that the company might with advantage have been brought out as the "Metallic Circuit Telephone Company," and thereby enlisted more subscribers than the "Mutual" arrangements could possibly bring.

Perhaps the company makes the best appeal to investors in its opening statement: "It has for many years been felt that the rates charged for telephonic services have been and still are excessive, that the use of the telephone has been, in consequence, greatly restricted, and that it is essential to the successful working and extension of the telephone system that the management of the central exchanges should be more in the interests of the users or renters than has hitherto been the case." There is little doubt that this feeling has been uppermost in the public mind for some years past, and any scheme to ameliorate the present condition of subscribers to the telephone will be hailed with universal satisfaction. The Mutual Telephone Company thinks that a suitable opportunity is now afforded to alter the existing state of affairs, and for establishing a working concern on the basis of substantially co-operative principles, and it bases this idea on the approaching expiration of the Bell patent.

It is proposed to provide a first-class telephonic service, both public and private, on the following terms:—Exchange wires (not exceeding one mile from the central exchange), at £5 per annum to holders of two or more shares, and £6 to other renters. For distances beyond one mile an extra charge will be made. Extra instruments in other rooms, or between one building and another, or between warehouses and works will be charged for at special rates, and it is claimed that the company's service will be the best known to modern telephony.

The promises of support in Manchester are very numerous, and the directors consider that they are warranted in immediately commencing the construction of their first exchange, in order to be in readiness for business at the close of the current year, when the Bell patent expires.

It seems evident that the intention is to employ magneto apparatus, for nothing whatever is mentioned respecting the use of carbon transmitters. It has long been known that certain forms of magneto telephones have been in operation, serving the joint purpose of transmitter and receiver, without being pounced upon by the holders of the Bell-Edison inventions; but, at the same time, such instruments have had but a very limited application, for it is not so much the receiver upon which we have to depend for a successful system of telephony as upon the efficiency of the transmitting apparatus. Mr. Mann, however, whose system of switching is to be adopted, states that there are no

patents other than Bell's which cannot be dispensed with; this, we take it, is a mere matter of opinion.

Provided that the necessary apparatus has been secured for reliable talk, both for short and long distances, there is much to be said in favour of the new company's method of procedure.

The proposed charges are based on a strictly limited return on the capital employed, and the dividend is not to exceed 6 per cent. per annum. Should the profits be more than sufficient to cover this, and to meet the needs of the company in effectively maintaining the plant and service, the subscribers will have the benefit of a corresponding reduction in rent. Perhaps to an outside shareholder the dividend might be considered small for a maximum; but as it seems to be to the interests of renters to become shareholders, the majority of those subscribing the necessary capital will probably be well satisfied.

A license has been received from the Postmaster-General authorising the establishment of exchanges throughout the country, and there is to be an entire absence of promotion money or commissions. We think that, on the whole, the Mutual Telephone Company starts under very fair auspices, and we cannot here do better than quote the last and appropriate paragraph of the report made by Major-General Webber upon the company's system.

"The day when the telephone monopoly (of which such bad use has been made) terminates, will see the birth of a new era in the use of this art which will be as startling in its effects on our daily business as was the invention of the telephone itself. This must yield a rich reward to those who, like the Mutual Company, foresee the great benefits to commerce which its extended use must produce."

If a system be adopted which will be found superior in operation to that now prevailing, there is no doubt but that the new company will receive great support from the public, and credit must be given to it for its attempt; but we fear that the directors have underestimated the difficulties yet to be encountered, especially in the question of "wayleaves," upon which the prospectus is ominously silent.

Voltmeter Calibration.

Apropos of an article on another page, we have examined the chart on which the readings of Prof. Weber, and those previously made by Messrs. Paterson and Cooper on the same Cardew voltmeter, are plotted. The lines are almost identical, the differences being only barely appreciable. This, we think, shows how well our manufacturers can calibrate the measuring apparatus they turn out.

The Sime-Edison Torpedo Cable.

AN interesting account of this electrical torpedo occurs in the *New York Herald*, special stress being placed upon the new form of cable manufactured at the Edison works at Shenectady. The previous cables which were imported were considered unsatisfactory, and as a consequence Mr. Edison invented a special concentric cable which form might with advantage, if the results are as stated, be adopted by the London Electric Supply Company for the Deptford station. "The cable is compound, having a small insulated conductor in the centre for the steering current produced by a battery on shore, and an annular conductor for the motor current. This cable has an unusually high insulation, having repeatedly been subjected to a tension of 24,000 volts without damage, the tests being verified at the time by a Thomson electrostatic voltmeter. The main insulation is in five superposed layers. Even one of these layers by itself was not pierced at 12,000 volts. Probably the insulation would stand a higher tension than 24,000 volts. Resistance of 6,000 feet of cable, six ohms. It is interesting to note that this splendid cable is made in America. Imported cables heretofore used have invariably failed in keeping qualities." The converse of this latter statement is what we so constantly learn from our own experience.

The American Census.

IT is proposed in the American census of 1890 to collect a complete set of statistics and data of the electric lighting industry. There can be little doubt of the great use such a collection will serve, and we anticipate some wonderful figures. By a glance at the intended list one will be able to see the number of electric light and power stations, number of lamps, the system used, whether underground or overhead wires, fires caused by electric current, fatal accidents, in fact, everything connected with electric lighting. Already many preliminary lists have been sent to manufacturers and the returns are in every way satisfactory. Although the industry in England has not reached the importance of that in America, some good results might accrue if the subject were broached here. We believe it is the intention of the Electrical Section of the London Chamber of Commerce to apply to managers of supply companies for particulars as to working. Might we suggest that they go further, and take up the subject of the census, which will, without doubt, meet with the hearty support of those interested.

Master Patents.

WE understand that Mr. Lane-Fox is about to make an attempt to claim his rights as the inventor of electrical distribution by means of accumulators in a parallel system. Sir William Thomson, Prof. Perry, Mr. W. H. Preece, Mr. Latimer Clark and Dr. Silvanus Thompson have all made statements in which they regard Mr. Lane-Fox's claims as being perfectly justifiable. We are not aware to what extent royalties are to be enforced, and as the reports of the experts are dated 1886, it seems rather late in the day to commence these proceedings; but we shall probably deal with this subject at greater length in another issue.

Lane-Fox or Edison.

WE have before us a tabulated statement compiled by Dr. Silvanus Thompson, comparing the salient features of the Lane-Fox and Edison electric lighting patents according to their respective priority. So far as we can gather from this document, the first named antedates Edison on every essential point which enters into the construction of the incandescent lamp as we now know it.

THE LINEFF IMPROVED SYSTEM OF ELECTRIC TRACTION.

PRELIMINARY NOTICE.

FOR various reasons which are now well known, there are at present only two distinct systems of electric traction applicable to street tramways in this country. The first is by storage batteries, and the second by the underground conductor system. With accumulator traction very little has been done except on the Barking line, by Mr. Reckenzaun, and more recently by Mr. Jarman in connection with the Clapham-Westminster Bridge section of the London Tramways Company, and upon which his first car, which is now ready for Board of Trade inspection, will shortly commence running. The underground conduit cable system, such as those at Blackpool and Northfleet, are suitable for short experimental lines, but, as a matter of fact, it has been found that local authorities are opposed to the slot system. This being the case, and as overhead conductors are out of the question, the ideal underground cable system seems to be that in which the current can be transmitted to the car motor without the use of an open conduit.

In our issue of January 27th, 1888, reference was made to the Lineff system of electric traction, and to a car tested at the Chiswick depôt of the West Metropolitan Tramway Company. It will be remembered that in this system Mr. Lineff employed a copper conductor drawn through a ¾-inch gas pipe which had contact pieces attached to it at intervals of 3 feet. This pipe was supported on brackets and castings, the latter of which supported the two rails forming the central slot. The castings were placed in a concrete trough which formed the underground channel. The current was taken from the conductor by means of a stranded steel cable hanging from shoes at the end of the car, the cable sliding over the contacts in the slot in the usual way. This system was to be introduced on the West Metropolitan Tramway Company's lines, but as the opposition of the local authorities to the slot was so great, the project was abandoned, and Mr. Lineff set to work again to perfect his system. He has now designed an exceedingly simple system by means of which a continuous current may be transmitted from the generating station to the motors on the cars without the use of an open conduit. The system is now undergoing a series of tests by experts, and a public trial of the first car will shortly take place. The following particulars represent the main features of the new method, but the information given must only be regarded as a preliminary notice, as some of the details of the system may yet be modified.

The system is of the closed conduit type with sectional conducting rails. The current will be taken from an electrical rail laid in sections, either at the inner side of one of the two rails or in the middle of the track. At the bottom of the conduit below the sectional rails is a bed of concrete and upon this and almost completely insulated by asphalt is placed the copper conductor. The top of the conductor is surmounted by a piece of hoop iron which forms the connection between the electrical rail and the conductor. Underneath the car is placed one or more electro-magnets. It will be evident that on the car passing on to the track the electro-magnets induce magnetism in those sectional rails upon which the car for the time being happens to be placed. The induced magnetism then attracts or raises the hoop iron, thus forming the connection between the conductor and the car magnets. The current then passes through the latter to the motor and thence by the car wheels to the track rails.

Electric Lighting Application Refused.—The Board of Trade have decided that, having regard to the objection lodged by the Corporation, they will not give their consent to the application of the Sunderland and District Electricity Supply Company, Limited, for an order for electric lighting in that town.

MR. FERRANTI ON HIS DEFENCE.

FOR a long time past, notwithstanding the dark and indefinite reports as to the condition of the Deptford central station, and the criticisms made thereon, the London Electric Supply Corporation has remained silent, and critics have been permitted to have their say almost without contradiction. Moreover, when the practicability of the huge Ferranti alternators and cables has been called into question, Mr. S. Z. de Ferranti has laughed in his sleeve and said to himself "We shall see." He has even scorned to make any reply to unkind statements regarding his machines and cables, and many persons have admired him for this indifference. Now, however, he has started on the warpath, and commenced the attack upon his critics. In last week's issue of the *Mechanical World* this young enthusiast writes:—

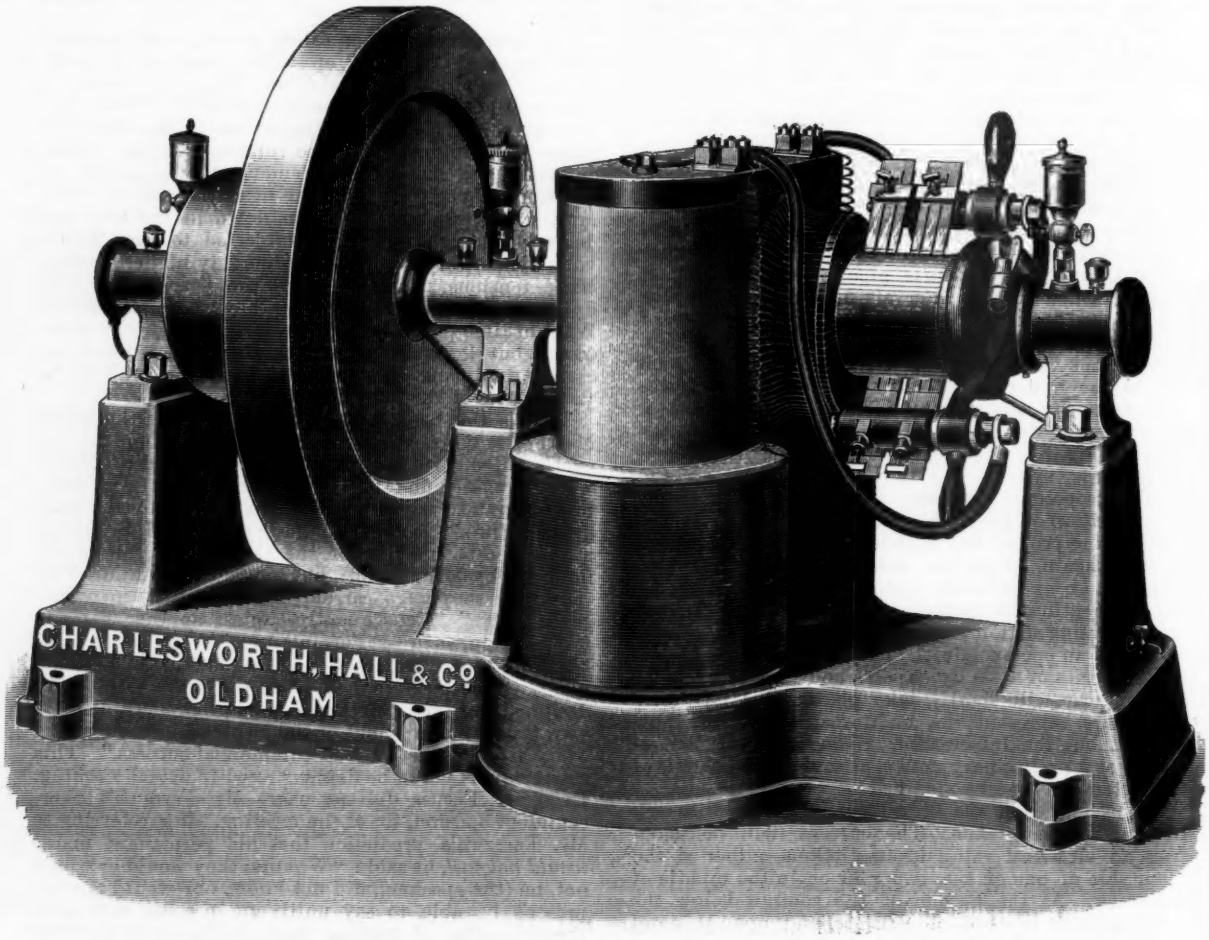
"My attention has been called to an article in your issue of the 12th inst. on 'The Deptford Central Station,' in which, amongst other things, you state:—'Many difficulties have been encountered. These concern principally the breaking down of the Ferranti cables.' I am at a loss to understand on whose authority you make the statements in the article in question. I beg to say that the insulation of the Ferranti mains has never broken down in the slightest degree, although repeatedly subjected to over 20,000 volts dynamical and very considerably higher electrostatic tensions. Neither have the bearings of the dynamos given any trouble since they were first bedded. Want of time prevents my answering any further statements, but I must request you to give this letter the same prominence in your next issue as that given to your article of the 12th inst."

This is the beginning, but what will be the end? Mr. Ferranti knows perfectly well that some of the cables failed. In his recent report he stated: "Mains were purchased and laid in the early part of last year, but I regret to say some of them have proved a very great failure." "These mains," said Mr. J. S. Forbes at the recent meeting of the Corporation, "were not designed by Mr. Ferranti, but in concert with Mr. Ferranti, and they were carried out by a great manufacturing firm." Consequently, unless another name is forthcoming, such as Ferranti-Ince, or any other combination, what denomination other than that of Ferranti mains can be given to them when they have been partly designed by him? Mr. Ferranti has, moreover, also his own type of permanent mains which he says "are in every sense a practical and commercial success." This assertion has yet to be demonstrated in actual working. Even Mr. Forbes did not share Mr. Ferranti's overconfident opinion, for at the meeting, after referring to Mr. Ferranti's prediction that his permanent mains *would not fail*, he said: "Whether they would or would not, he (the speaker), did not know, nor would anyone present be able to say until one process was gone through—that of putting them in the earth, covering them up, connecting them with the supply in houses, and turning the current on. Then if they had any weak places they would be revealed, just as the weak places were revealed in the mains which had failed."

These two sentences are the very essence of the whole undertaking. It probably answers his own purpose when Mr. Ferranti states that his mains have been tested at an E.M.F. of over 20,000 volts, but the testing of half-a-hundred 20 feet lengths of his conductors is, as compared with what they will, or perhaps it would be better to say would be called upon to perform in actual working, purely a laboratory experiment, and until this young engineer can demonstrate that his mains are what he pretends them to be he had better devote his time and attention to the perfecting of his cables, if it be possible, rather than wasting words in writing contradictions to the Press and laying himself open to even harsher criticism than that to which he has hitherto been subjected.

GAS ENGINE DRIVEN DYNAMOS.

MESSRS. CHARLESWORTH, HALL & CO. send us the following particulars of one of their dynamos, designed to be driven by a gas engine :—These machines are carefully worked out mechanically as well as electrically, and the lubricating arrangements are convenient and perfect. Each bearing is fitted with a special sight-feed lubricator, which, when once adjusted, can be turned on or off, and increased or decreased at any time when found necessary. They are also fitted with two simple siphon lubricators, which are intended to be used if any of the bearings should become heated. The waste oil is caught in the enlarged ends of the pedestals, and runs from these into the insides of the pedestals and down into the standards carrying them, exactly in the centre. The armature frame is of strong aluminium brass, and the core, which is 12-inch diameter, is built up of soft charcoal iron discs insulated from each other, and has an area of 40·5 square inches. The commutator bush is a steel casting, with wrought iron nut and washer, and is 6½-inch diameter ; it has 80 hard drawn copper bars, 1 inch deep, and is insulated entirely with mica. The armature is wound with 200 convolutions of one No. 8 B.W.G., and has a resistance of ·045 ohm. The magnet is shunt wound only (for charging accumulators), and each leg is wound with ten layers of No. 14's and sixteen layers of No. 15's, and has a total resistance of 31·6 ohms. There are two brushes on each side of the commutator, each of which can be adjusted independently of the other. These machines work without any sparking with the full load ; when working lamps the normal load is 150



and can be drawn out as required. These arrangements keep the machine entirely free from oil except where wanted. The bed-plate has been extended to support the extra weight of the flywheel, which is 30-inch diameter, and weighs about 6 cwt. After being turned all over, this has a wrought hoop, previously bored, shrunk on, and then turned up. The shaft is of hard steel, and is 2-inch diameter in the bearings at the pulley end, and 1⅞-inch at the other end. The bearings are of aluminium bronze, each 8 inches long. The pulley is 13-inch diameter, and carries an 8-inch belt. The bed-plate is of massive construction, and well ribbed to withstand rough usage in transit and fixing.

The magnet cores are of soft charcoal iron, fitted into holes bored through the bed-plate, and secured in their places by screws. The pole-pieces are in one forging with the magnet cores, and are bored from the pedestals to receive the armature, which is placed

ampères and 100 volts at 670 revolutions per minute, and 150 ampères and 140 volts at 820 revolutions when charging accumulators.

THE CARDEW VOLTMETER.

PROFESSOR H. F. WEBER, of Zürich, has been testing some Cardew voltmeters recently ; his report, written in English, a copy of which is before us, reads as follows :—

"In the laboratories for alternating current work of the Electrotechnical part in the new Physical Institute of the Federal Polytechnical School at Zürich, I use twelve Cardew voltmeters of MM. Paterson and Cooper to measure potential differences between 20 and 1,250 volts.

"After receiving these twelve voltmeters I have made very numerous and exact measurements to get the differences between the indications of these voltmeters and the true values of the potential differences.

"The results of *all* these measurements were *very satisfying*, as will be seen from the following series of comparison :—

Voltmeter, No. 612.		Voltmeter, No. 613.		Voltmeter, No. 614.	
Value.	Indication.	Value.	Indication.	Value.	Indication.
Volts.	Volts.	Volts.	Volts.	Volts.	Volts.
24·15	24·23	24·15	24·07	64·50	65·00
28·17	28·47	28·07	28·13	70·81	71·30
35·92	36·42	35·92	36·28	78·81	79·41
44·02	44·40	44·12	44·50	82·96	83·40
52·17	52·57	52·17	52·70	87·01	87·71
60·35	61·00	56·17	56·77	91·20	91·60
64·86	64·46	60·35	60·97	99·40	99·70
69·29	69·00	69·29	69·28	107·61	107·71
77·09	77·00	77·09	77·46	111·72	111·90
85·40	84·80	85·40	85·34	115·72	115·81
93·75	93·20	93·75	93·43	119·70	119·70
101·88	101·24	101·88	101·80	...	...
110·10	109·48	110·10	110·35	...	...
122·10	122·49	122·10	122·39	...	...

"Zürich, *April*, 1890.

"Prof. H. F. WEBER."

These results are very satisfactory. Messrs. Paterson and Cooper having furnished us with the calibration curves of the instruments which show their values for the volts referred to the deflections of the pointer, we have plotted on the same curve the above differences, the remarkable agreement between the makers' values and those of Prof. Weber being then more manifest.

HORN'S ELECTRIC TACHOMETER.

IT is not unfrequently the case that inventions possessing undoubted merit fail to make their way owing to the want of commercial enterprise on the part of those who control them.

Nearly two years ago we illustrated and described the action of this tachometer, which struck out a perfectly new line, and undoubtedly possessed merits sufficient to give it a position quite apart from the usual forms of these instruments. Founded upon Arago's discovery of the formation of currents in a copper disc rotating in a magnetic field, its construction is so disposed that while employing permanent magnets the calibration of the instrument remains the same, although the strength of the magnet may alter. This most important point has been very fully proved by going so far as to reverse the polarity of the magnet and again restoring it, after which, in every experiment, the calibration of the instrument has shown itself to be unaltered. As it is extremely improbable that the degree of magnetism after each experiment was the same, it is clear that the indications of the instrument are not affected by any such changes of magnetism as would result from time only.

Inasmuch, again, as the instrument is entirely independent of the action of gravity, it is especially adapted for use at sea, when the ordinary tachometer working by centrifugal action is liable to serious errors due to the motion of the ship. Further, the absence of delicate fitting, which is so necessary in the old type of instrument in order to minimise friction, enables the electrical instrument to be produced at a price below any other form, and it may be treated with much greater freedom without fear of upsetting the correctness of its readings.

The necessity for tachometers in all moving machinery is being thoroughly recognised, and inasmuch as the new instrument can be made equally well either for permanent use or in a portable form, both for laboratory and every day work, and giving direct readings without any necessity for time measurements, its application will, without doubt, enormously extend.

The instruments have been employed in Government departments and leading engineering shops and have given most satisfactory results.

We hear that the rights of the invention for England and the Colonies are now in the hands of Woodhouse and Rawson United, Limited, who will no doubt vigorously push forward the knowledge of an instrument which possesses such undoubted merit.

THE MANAGEMENT OF ACCUMULATORS.

By J. K. PUMPELLY.*

II.

IN the first paper on this subject the point was reached where, having made a set of batteries, we were putting them through a process of forming. Suppose, now, according to the chemical calculations before mentioned, the plates have a surface and atomic capacity of 100 ampères ; practice has shown that a current of one-tenth the full capacity, or about five ampères to the square foot of surface, is the safest to use in charging a cell. The dynamo is regulated, either in its make or by introducing between the dynamo and the battery a resistance coil, to deliver through the battery 10 ampères of current. If this is continued for ten hours, it can be estimated that each cell has received a charge that is supposed to be sufficient to make such chemical changes in the plates, that (in the reversal of chemical action that takes place in the discharge) energy to do the work of 100 ampères, or nearly this, is the result.

Practically there is a loss of 14 per cent. of energy by this conversion. This means that with an electromotive force or pressure of two volts, which is that of one storage battery cell in discharging, one ampère of current can be forced through a small lamp, to light it, or may revolve the armature of a motor, for 100 consecutive hours. We now have an idea of the size of the ampère current advisable for charging an accumulator of 100 hours' capacity. And it must be understood that this same current, continued 10 hours, produces the same chemical change in all the cells, however many there may be ; but when the electromotive force is to be calculated as necessary, it is only necessary that there be enough—a surplus does not concern us ; but there must be a pressure in volts of $2\frac{5}{10}$ to each cell, hence 30 cells would demand an electromotive force of 75 volts. A thousand more volts than this would do no harm nor any good.

If the calculation as to the capacity of the cell or battery—for an estimate of one cell is an estimate for all—in the circuit is eight, then, when 10 hours have been consumed in delivering from the dynamo 10 ampères per hour of current, there will be signs of disturbance on the surface of the battery, and the fluid or electrolyte will look as though boiling, and become milky ; this is generally a sign that the battery is charged. To explain this appearance, it is supposed that all the surface of the positive plates or electrodes have absorbed, or in some way taken to themselves, as much oxygen as they will receive, which oxygen has come from the decomposition of water, and the surface or exposed atoms of the negative electrodes have absorbed all the hydrogen they will ; then, if the current from the dynamo is continued, and the water is still being decomposed, both the oxygen and the hydrogen will come to the surface (hydrogen in quantities at the negative pole and oxygen at the positive) and thus produce a bubbling action.

If, however, a battery is badly made, or the plates are poor and non-absorbent, this bubbling will appear in a short time. Such a defective cell should be removed from the circuit. When a battery is partly

* *Electrical World.*

formed, as often happens, or has been charged and discharged a few times only, small bubbles of hydrogen gas come to the surface at the negative pole all the time, but when a discharged battery is well formed, and the plates are of a dark colour, especially the positive plate, this bubbling at the negative pole does not take place for a long time—in fact not until it is nearly charged.

We have now charged our battery 10 hours with a current of 10 ampères and with 30 cells in circuit, and used an electro-motor force of 75 volts. We may expect to get out of these cells nearly 100 ampères; but this success will depend very much upon the economical way in which the battery is discharged. We have in our 30 cells a pressure in volts of 30 multiplied by two, and for convenience we discharge through a 60-volt incandescent lamp, which needs a current of one ampère per lamp and an electro-motor force of 60 volts, to produce a light of 16 candle-power; hence we could expect to light this one lamp 100 hours, or we might burn five lamps 20 hours; but if we discharged the battery through 20 lamps, *i.e.*, with a current of 10 ampères more than was used in charging it, we would probably notice a short time before the full five hours of burning had been completed a drop in the candle-power, showing a loss of electro-motive force.

This may be because the chemical change produced in charging with 10 ampères cannot be reversed in the discharge so much more rapidly, and still produce all the chemical action needed to get the full work out of it; probably the reversing of the oxidising and hydrogen absorbing process does not take place as rapidly, there not being the same force or push behind it in the discharge as in the charging. We say *probably*, because it is a very convenient word in explaining phenomena not understood; but the truth is, neither scientist nor chemist knows much about the action of a storage battery, and the writer confesses, perforce, to the same ignorance, and speaks of what he sees in the action of an accumulator, but guesses at the rest.

The question is naturally asked by those who purchase accumulators, and wish to recharge them: "How is it determined when a battery is fully charged?" The answer must be: "There is no certain way of knowing; an approximate idea may be reached by noticing the boiling on the surface of the electrolyte as before mentioned, and by the acidometer it is found that the electrolyte increases in density as the cell is charged." If it shows by the reading of the acidometer, which is left to float in the electrolyte, that its specific gravity has increased from 1,150°, its density when first poured in, to 1,210 or 1,220 toward the end of the estimated number of hours of charging, then it may be taken for granted that charging has been continued as long as necessary. But as "in dry weather all signs fail," so is it in this far more uncertain element.

As we get work out of accumulators through a constant change and movement of atoms, no instrument can measure what is seemingly held in it. Everything is estimated in the following uncertain way. If the plates are of a certain size and weight, and of a certain number, and are all alike in nature, colour and material, and properly put together, and are charged with a certain constant ampère current, sustained by a sufficient pressure in volts for a certain number of hours, *then* you may expect to get efficiency out of it equal to the efficiency put into it, minus 14 per cent., if you discharge it as carefully as you charged it. If, however, one cell in the circuit is not in the same favourable condition, a thing very likely to happen, and that cell remains in the circuit, then the result is not so satisfactory.

Our next section will treat more minutely of the practical, everyday handling of accumulators and their uses, and the forms of different styles of accumulators.

Water-Power in Turin.—The Town Council has just adopted the project of Mr. Soldati, according to which, the water-power of the Giandone torrent will be used for electric lighting purposes.

THE TELEGRAPHERS' FAST-SENDING TOURNAMENT.

By PATRICK B. DELANY.*

AS there are forty or fifty thousand people talking about the young Yankee Pollock, who brought his bundle of thews and nerves down from a Connecticut town, and coolly stretched the record out of reach at the fast-sending tournament, we might as well see what this cheeky manipulator really did. In his first trial he poured out a stream of dots and dashes to the tune of 51$\frac{3}{5}$th words per minute, and then, like Mark Twain's coyote, when his speed was questioned, let out another link in his backbone, and shoved the record up to 52 words per minute, making 260 words in the five minutes given to each contestant. It is claimed, and with some reason, that the work was not plain and perfect. I know that the sending of Messrs. Gibson, Ayres, Waugh and Bradt was vastly superior as to quality, and of such a character as not to fly off the poles in turning sharp angles; but still I think the "Yankee Blade" made all the signals, and that the lack of clearness so noticeable was, in a great measure, due to the great speed and his lightness of touch.

It has been the custom heretofore for commercial operators to turn up their noses at the railway operator, and Pollock seems to have made up his mind to avenge the slights and indignities so long and lavishly heaped upon his train-guiding brethren. Admitting that his juggling of the signals had many of the characteristics of a railway accident, still, every time I caught the thread of his discourse, I found him putting it all in honestly. I couldn't follow him all through. Even the air-brakes seemed powerless to hold him. He was a sort of runaway train going down grade, and if the time-keeper hadn't opened the switch on him, there is no telling where he would have fetched up. Now if Pollock, jun., made all the signals, I claim that, regardless of classicality, he has performed a wonderful feat, and I am strongly of the opinion that so great a number of impulses of any kind have never before been made in the same time.

I have been experimenting a little since the tournament, with a view of ascertaining whether, if Mr. Pollock had made all dots, he could have crowded any more into his record than the number of mixed dots and dashes credited to him; and I have come to the conclusion that the almost infinite number of changes involved in the transmission of the English language by dots and dashes is restful to the operator, and that if he were compelled to make the letter "p" or figure "6," consisting of all dots, at top speed, for five minutes, his muscles would be practically paralysed. It is easily tried. Others may find it different.

Since Fast-Sending Tournaments promise to increase in interest from year to year, I have no doubt that certain improvements will be made in their arrangement which will contribute to the speed of the operators and to the certainty of decisions by the judges. Nothing was plainer than the consideration and fairness of all connected with the tournament just closed, but when writing climbs up into the fifties, it becomes very misty, and faults are difficult of detection. I have many times tested the limit of sound reading by using a punched strip and machine transmission. Sixty to sixty-five words per minute can be followed, if the matter be familiar to the ear, or with the manuscript before the listener, but this must be from a strip carefully punched. I think, therefore, that a Wheatstone recorder should be used for receiving the writing of each contestant. This instrument, properly adjusted, will record over 500 words per minute, so that there need be no fear of anything being missed. I would suggest also that a condenser be used to prevent sparking at the key points, especially if a considerable number of sounders are to be used in the circuit. It occurred to me and some others that one first-rate sounder placed in the centre of the hall would

* *Electrical Engineer.*

be more satisfactory than a number scattered about, some well-adjusted, others not. With a single sounder there would be a unanimity of opinion regarding the quality of the work.

An analysis of the real meaning of Pollock's wild flight is interesting. It shows that the 260 words transmitted in five minutes call for 1,223 letters and 11 punctuations, or say 1,234 letters in all. To make these letters 2,834 impulses were required. This puts over nine impulses into each second; and, as each impulse calls for a down and up motion of the key, the hand and fingers of the "Railway Guide," from Hartford, had to make nearly 19 movements per second for 300 consecutive seconds. If any one thinks he carries more agility than this about his person, fame awaits him—if he is not mistaken.

I doubt very much if there be any one living able to write out words at this speed. Forty-five words per minute will claim any man's undivided attention, so that until the penmen can put more steam into their fingers Pollock's gait would be useless, even if it could be maintained—which it could not. It is fair to assume, however, that a man who can do 52 words per minute in any shape might send grandly at the rate of 45 words per minute. If the elder Catlin's pace and beautiful style of transmission were general throughout the country, and there were receivers to put it down, the earning capacity of the telegraphs would be just about doubled. Here is something for managerial meditation. There is money in it. When a boy like young Catlin, not yet old enough to vote, can double the work of an ordinary circuit, he becomes a duplex. He should be encouraged.

To my mind the great speed and general excellence of the work of the young women was the most remarkable feature of the contest. It was a revelation to one who has not been very close to the sounder for some years. I considered 32 or 33 words per minute the winning speed in their class, but how the glory of old times faded when 43 and a fraction were poured out with ease and grace without untying a bonnet-string. I think the quality of the young women's work averaged higher than that of the men.

I find that there are 636 dashes in the 260 words sent by Pollock, or an average of about one dash to two letters. Five letters to a word is the usual way of reckoning. If Pollock had to furnish five letters to a word, his score would be 246$\frac{4}{5}$ words. But 4$\frac{3}{4}$ to 4$\frac{7}{8}$ is nearer the average. This may be proven by counting the letters and words in a few columns of the editorial page of the New York *Sun*, any day.

In the first 50 words of the 260 there are 600 Morse characters: in the second 50 words, 566; in the third 50 words, 531; in the fourth 50 words, 532; in the fifth 50 words, 503, and in the 10 words which distinguished Pollock, there are 102 characters. There is a difference of 97 characters between the first 50 words and the fifth. This is equal to five words. As young Catlin sent 251 words and one letter, or 2,738 characters, he is just 96 characters behind Mr. Pollock.

Here is what was done by each contestant, the names being in the order printed on the official programme:—

Ladies' Class.

	Words.	Characters.
Millie Moss	191-4	2,156
T. V. Froschel	200-5	2,241
B. M. Dennis	212-4	2,328
K. B. Stephenson	217	2,367
Annie M. Schaffer	193-2	2,176
J. Schlesinger	207	2,296
E. V. N. Garthwaite	201	2,245
M. C. White	169	2,003
L. Wagner	185-4	2,096
A. E. Findley	193	2,170
M. A. Daley	186-1	2,099
E. R. Vanselow	210-4	2,327
S. C. Barry	197	2,196

Old Timers.

	Words.	Characters.
J. H. Dwight	138-7	1,553
Fred. Catlin	217	2,367
A. S. Ayres	229	2,514
G. M. Eitemiller	197-4	2,215

Class A.

	Words.	Characters.
A. J. Swan	215-2	2,342
F. L. Catlin	241-1	2,635
F. L. Catlin (second trial)	237	2,602
H. S. Wright	203-2	2,267
H. D. Paulhamus	218-7	2,391
W. L. Waugh	229	2,515
J. P. Bradt	224	2,464
W. Davis	195	2,187
W. Davis (2nd trial on account of time error.)	194	2,175
M. H. Toomey	230-4	2,530
J. W. Roloson	248-3	2,707
J. W. Roloson (second trial)	246-2	2,682
R. B. Pollock, jun.	258	2,811
R. B. Pollock, jun. (second trial)	260	2,834
W. M. Gibson	239	2,622
W. M. Gibson (second trial)	238-4	2,617
U. Peters	217-2	2,411
F. J. Kihm	238	2,609
G. W. Simmonds	221-1	2,446

Class B.

	Words.	Characters.
W. L. Waugh	229	2,515
Ed. Bishop	193-3	2,178
J. G. McCloskey	209	2,305
A. J. Swan	212-8	2,354
Frank English	225	2,471
H. S. Wright	211-1	2,334
D. Wark	224-1	2,464
H. D. Paulhamus	224-1	2,464
M. J. Doran	213	2,359
M. H. Toomey	228-6	2,510
F. L. Catlin	251-1	2,738
R. C. Mecredy	220-9	2,442
W. A. Jones	223	2,461
O. Hart	222	2,456
J. P. Bradt	220-2	2,447
C. W. White	218-8	2,429
A. S. Patterson	201-4	2,248
J. D. Hinnant	214	2,356
F. F. Norton	211	2,333
E. A. Sprong	203	2,256
W. Davis	193	2,170

There were 13 women and 34 men in the contest. Taking the highest figures of each contestant they foot up a total of 9,955 words transmitted, or an average of nearly 42$\frac{1}{2}$ words per minute for each of the 47 operators. The women averaged 39$\frac{2}{5}$ words per minute, the men 43$\frac{1}{2}$. All praise to the ladies. Great is Pollock.

SHIP LIGHTING.

SINGLE *v.* DOUBLE WIRING.

By F. B.

A SHORT time ago Lloyds' agency issued a circular to electric lighting firms calling attention to the fact that fires had occurred on ships fitted with the electric light through defects in the insulation of fittings and wires, and invited suggestions both as to methods of installation and means of maintaining the insulation of wires and fittings unimpaired, so as to eliminate as far as possible the risk which at present appears to attend the use of the electric light.

The *Electrical Engineer* of April 25th published a copy of this circular, together with what purported to be a typical reply of the firms addressed. It might be a sample of the replies of London firms, but certainly no northern firm would condemn the "single wire" system in that style.

An obvious inference from the letter referred to is that ship installations, as at present erected, must be necessarily of a very inferior description, because the prices at which they are undertaken are so low that no London firm can compete. It is, however, perfectly clear that in the case of boats built upon the Tyne, the Wear, or the Tees, a northern firm could do the work cheaper than a London contractor; one reason, among others, being that labour is cheaper; similarly in the cases of Clyde and other Scotch steamers.

From the tone of the letter one would conclude that all work not carried out by a London firm should be suspected. Fires, however, sometimes occur in London through bad workmanship. On ships, as on land, to reduce fire risks to a minimum, good workmanship is essential. All ship fittings should be of a very rigid nature and mechanically strong, the terminals to which the wires are brought being as far apart as possible and not liable to derangement by any motion of the ship. This condition is best secured in single wired fittings. All cabin fittings should be supplied with safety fuses calculated to fuse upon the passage of a current 50 per cent. in excess of the normal. Single pole fuses should be placed upon all branch circuits carrying six lights, the fuses being always placed upon the same main, otherwise an excessive current might leak between the positive and negative branches of two independent circuits without passing through a fuse. For instance, suppose + A and − A to be a branch circuit; also + B and − B to be another branch circuit; if single fuses are placed upon + A and − B there is nothing to prevent − A and + B burning each other out. Why not use double pole fuses? Because they not only do not overcome the difficulty but rather increase it. For it is not a common occurrence for both fuse wires to break at once, neither is it always the same wire that breaks. It may be a positive or a negative, so that the remaining wire will still allow a current to leak to the ship to the extent of the carrying capacity of the fuse—and it does not require a large current to originate a fire.

Hence, if we can ensure that single pole fuses will always be placed upon the same pole we are far safer than in using double pole fuses. The only way to ensure this is by using a single wire system. As a rule, a leak takes place from some short length of conductor, commonly a joint, or a part that has become saturated with seawater. Electro-deposition goes on; the positive conductor becomes thinner at the faulty place, and in course of time becomes so much reduced that the normal current heats it sufficiently to set fire to the insulation. This action will be hastened if the fault be at a joint, as the copper is deposited upon the solder very rapidly. I have known dozens of fires occur on land from this cause. No fuse can remedy that. This, then, affords another argument for a single wire system; by making the ship the positive pole no thinning of the conductor could take place, hence no fire from that cause. All wires should be kept if possible out of the reach of seawater. Where this is not possible, they should be protected by an iron or lead sheath. Wood casing is no use in wet places, it only accumulates water in the grooves. In single wire systems (when carried out by a responsible firm) all wires in damp situations or where they pass along or through ironwork, are very heavily insulated and protected by a galvanised iron sheath, the outside diameter of a No. 16 wire, so prepared being nearly half an inch. I have known such wires to be continually wetted by "seas" and also subject to rough mechanical usage without being damaged. All joints on the sheathed wire are enclosed in iron castings made perfectly water-tight. These wires not being enclosed in casing are always visible, so that any fault is at once detected and easily remedied.

The principle objections urged against the single wire system—which are doubtless based more upon sentiment than fact—are that insurance companies prohibit it on land installations and no difference should be made in the case of ships; and that if a wire comes in contact with the iron of the ship a fire might be caused, whereas, upon a double wired ship no harm would result. To take the first objection, I should say that there is no analogy between a ship and a house. If houses were made of iron, and salt water was always running down the walls, it would be a fair comparison and it would be doubtless found that a single wire system was preferable.

As to the second objection, it is difficult to think that it was meant seriously. In the first place, it is almost an impossibility for any but the ship wire to come in contact with the ship. In the case of portable lamps, the flexible cables are concentric, the outer wire being the "ship" wire, so that the danger is considerably less than in the double wire system. For supposing in the latter system there is a slight leak on the portable fitting, it is almost certain that if it touched the ship (that is the iron work) there would be a slight spark. If this occurred in a petroleum tank we should probably hear of the *explosion on a petroleum vessel*. Again, it is said that if one wire on a double wired ship gets to "earth," it would not matter very much. This is rather startling, for the engineers are not *all electrical engineers* (see definition by S. F. Walker), and they would not detect the fault. The safety of the ship would then be dependent upon a *single wire*, most probably an ordinary unsheathed wire in wet casing, for there is not much sheathed wire used in double wired ships. In such a case I should infinitely prefer being on a single wired ship.

Shipbuilders who have had many ships wired, and electrical engineers who have carried out much ship work, testify to the vast superiority of "single" over "double" wired installations. I hope shortly to be able to give the relative insulation resistances of installations on both systems; 1st, when newly erected, and 2nd, after a few months at sea.

TRADE AMENITIES.

[A COMMUNICATION.]

THE trade of the electrical engineer is essentially modern; so are his ways of doing business. It follows that his raw material is plastic, and adapts itself readily to its surrounding requirements. It is this feeling of adaptability to something which prompts him to turn his attention to electricity. If it is not, he soon discovers himself to be a waster, or others do; and he treads *nolens volens* a more congenial, or, at any rate, another walk.

Electrical engineering was born at a time when the old conditions of trade were altering. The manufacturer had sold to the wholesale house, that to the retail dealer, and the latter to the user; but a cry had gone up against the middleman and his profits. Why this much-abused individual should not have been deemed worthy of his suburban villa I will leave to your readers to *pro* and *con* if they choose in your ever-open correspondence columns, only remarking that a great deal of nonsense has been talked, and, perhaps, too much righteous indignation brewed out of the subject. Anyhow, the "stores" had started. Anon drapers took to selling Christmas cards and crockery, and in all directions trade was being "cut to pieces."

The internal necessities of the business in its early days demanded that the worker should sell direct to the user, for the middleman was non-existent. There was no place for him; so he had not developed. The electricians, fired with faith, made him. There was no real demand on the part of the public: this also had to be made. Gradually the mountain was moved, a very little bit at a time, mostly at a loss to the movers. Clearly there was no place, in such a state of things, for that middleman. Among all the sins laid to his charge, he never was accused of living on losses. The same instinct which prompts the rat to leave a sinking ship doubtless inversely inspires the middleman to enter one fairly afloat. The originator may be, probably is, an enthusiast, as also the adopter; but in the middleman sentiment is replaced by a longing for the turn on trade discounts; the commercial instinct serves him for a soul.

We are constantly hearing of one and another firm being aggrieved by the action and methods of another in pushing business. Some firms hold that for a manufacturer or supplier to offer to their customers is immoral. Morality in such matters is a shifting sand, not easily mapped, and often a mere question of opinion. It seems that competition for custom is wholesome, if conducted with common fairness. To

take an imaginary case, where a firm of contractors, having sublet to another firm the wiring of a house, the latter endeavours to obtain an order for the fittings direct from the client, no one with a sense of honour would call this fair competition. Every profession has its black sheep; they need no marking, the colour betrays them. When a firm cancels an order just placed, because the same terms have been quoted to another which the first does not consider as "wholesale," it sets one thinking whether, in judging another, it is not condemning itself. Who is wholesale and who is retail in the electrical trade? Correctly speaking, anyone who supplies the public direct is a retailer. Did ever any electrical man get an order that he refused on the score that he only dealt wholesale? I trow not. The attempt to affect that there is such a thing as a genuine wholesale electrical business is cant, the expression of the feelings of those who, having much, desire it in more abundance at the expense of those who have little. Every company or firm which puts up an installation for a private customer is a retailer. The middleman or wholesaler, as he would call himself, creeps in where he can, and howls lustily at the small contractor who would buy first hand of the manufacturer. Why should he? He may be useful to both manufacturer and contractor, taking large quantities from the former, and having everything ready at hand for the latter. But he has no prescriptive right to existence beyond the place he fills in it to mutual advantage. At present it is certain that electrical engineers having, like the heathen, no law, are a law unto themselves; they do, every man, what in trade matters is right in his own eyes, and probably will continue to do so. There is no tribunal yet to settle etiquette.

In April, 1883, an association of electric light companies was formed, comprising nearly all the leading firms of the day—they were not many. They were to consider trade questions. They had some three meetings, and collapsed. There is the electrical section of the London Chamber of Commerce; but that is supposed to deal with the relations of the trade to the community. The Institute interests itself with the technical side, and the Electro-Harmonics with recreation; it would not do to destroy their harmony by discussion. You recently announced a new proposed association of electric light companies; it may be they would like the office, but I doubt it. In any case no self-constituted body could fairly try the issue. The last mentioned, supposing it to work harmoniously, may have more the character of a ring than a representative body, and could hardly be impartial, and when pressed, might suffer from the tangential influence which broke up its predecessor.

For my own part, I think the commercial etiquette of the electrical engineering trade may be left to settle itself. With the trade's growth will grow a "custom of the trade," which, when it *is* a custom, will be recognised, and sinners against it be in fear of suffering; but as yet there is no law, and consequently no sinners.

The Whitehall Club has opened its portals to the *élite* of the profession, a chosen few. There is no fault to find. It is meet that the engineering club should recognise its offspring. No one can object to the affiliation order that has been granted. But the *coterie* is not representative; it is selected, not elected. What is wanted is a club to which anyone would be welcome who, provided of course he bore a good character, was in any way connected with operations depending upon electricity. It would not take long to turn such an idea into a fact. The army of workers is already sufficiently numerous to found one of real strength. It should have a democratic character and trust to its roots for support. It should have for its object the social intercourse of its members, and the good of the trade, a combination of business and pleasure, in the nature of the ancient coffee houses. The subscription should be as small as possible, relying on its multiplication by many for a sufficient amount to carry it on prosperously. Such a clubhouse for electricians would, I predict, not only be welcome but beneficial all round. Situated, say, between Westminster and the City, in which places they most do congregate, much business might be talked pleasantly over and transacted. A night now and then for the discussion of trade matters (technics barred) might follow. It might be sufficiently removed from Whitehall to prevent its aroma from offending the nostrils of the sacred fifty, who would perchance occasionally find their way to its temple by a back street, to diffuse sweetness and light, and lend their recently-acquired experiences of club manners and management to its development. Is it resolved by acclamation that the club be founded?

D. H.

THE WALLER-MANVILLE SYSTEM OF ELECTRIC TRACTION.

THE essential feature of this system is the employment of a flexible conductor sufficiently small to permit of its being placed in, or withdrawn from a conduit through a slot.

The conductor being flexible, the supports can be at long intervals; and can therefore be placed in side openings to the conduit itself. By this means space is provided for large and efficient oil insulators.

Removable covers are provided to these side openings or hatchways, giving ready access to the insulators. The insulators are mounted in such a manner that on removing the cover they can at once be lifted out.

The collecting arm is designed so that the shank can be withdrawn through the slot, and the collector proper (or brush) through any hatchway.

Under ordinary conditions the conductor simply rests on supporting arms without being attached thereto. When it is necessary to firmly attach the conductor to its support, as for instance on sharp curves, absolute flexibility is still maintained, as the supports are so designed that whilst rigidly resisting either a longitudinal or a lateral strain, the same freedom of upward movement is allowed as in the case of the conductor itself when unattached.

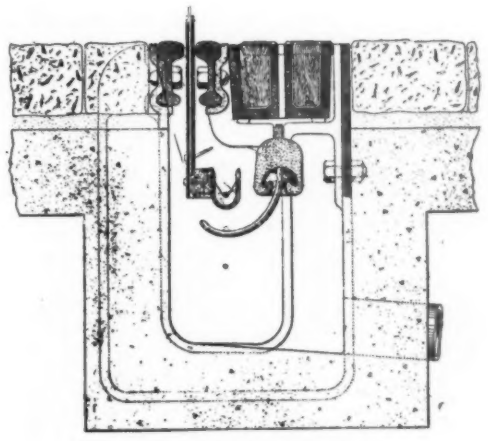


FIG. 1.

Simple automatic apparatus is provided at intervals to maintain a constant strain upon the conductor. The current is collected by means of a U-shaped collector in which the conductor runs; the collector lifting the conductor off the ordinary supports during its travel, and, in the case of those supports to which the conductor is attached, lifting the support itself.

Fig. 1 is a cross section through a hatchway and shows the ordinary form of curved support on which the conductor rests, and the oil insulator to which this support is attached. The conductor is shown lifted off

the support by the collector. Details of the collecting shoe, showing the arrangement for detaching it from the shank, are given in figs. 1, 2 and 3.

In cases where a double conductor is used, the arrangement is duplicated, the insulators and cables being arranged one on each side of the collector arm.

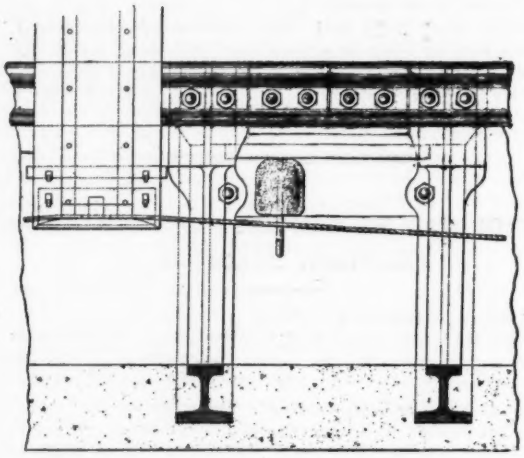


FIG. 2.

Fig. 2 is a longitudinal section through the tube, giving a front view of the curved arm and a back view of the collector.

For turning round curves a swivelling arm is mounted on oil insulators. The conductor is held by this swivelling arm, both being lifted by the collector, thus maintaining the flexibility of the conductor as regards upward movement, while rigidly resisting either a longitudinal or a lateral strain.

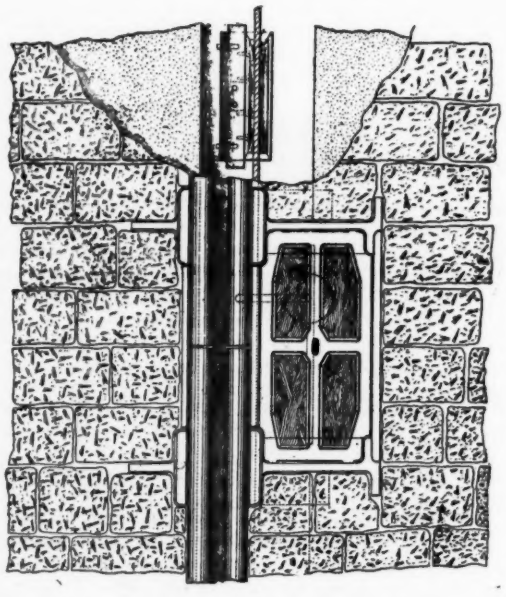


FIG. 3.

Fig. 3 is a sectional plan showing a hatchway. These hatchways would be placed about 30 feet apart.

Figs. 4 and 5 show respectively a side and front elevation of the tension or straining gear. This consists of a gun metal plate or yoke mounted on two swivelling arms and supported by oil insulators, and provided with small pulleys so arranged that the conductor, or cat-gut cord in continuation of the conductor, is led to one side, so that a balance weight can be attached thereto. This weight serves to keep the sag of the conductor between its supports constant in all changes of temperature.

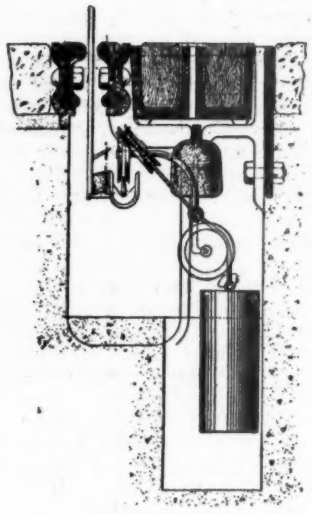


FIG. 4.

As the pulleys are arranged on the swivelling arm, the whole apparatus is free to lift in a similar manner to the single swivelling arm, the conductor being led through an eye in the shaft on which the apparatus revolves, the upward or downward movement of the tension frame in no way affects the length of the conductor, and consequently no resistance to this movement is caused by the weight of the counter-balance. This tension gear would only be required at long intervals, occurring, say, every quarter of a mile.

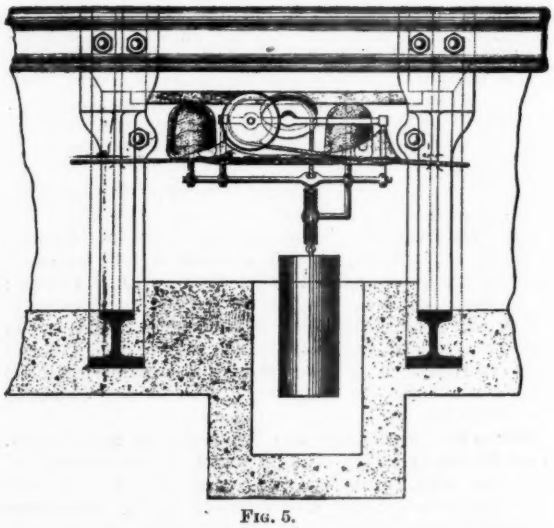


FIG. 5.

It will be observed that this invention relates entirely to mechanical details, and that no new electrical conditions are introduced, which might involve an element of uncertainty. The system is applicable to the distribution of electricity from a central station by any known method, whether in parallel or in series, or employing one or two conductors. It can be laid in a conduit situated either beneath one of the ordinary track rails, or between the rails, or outside the track.

The first method is generally preferable for new

lines, as being less costly and exposing less metal on the road surface.

The second method might be desirable in some cases, for instance, in the conversion of a cable tramway into an electrical line. The fact that in this system none of the electrical parts are built in would enable this conversion to be made without practically interfering with the traffic on the line.

The last method is suitable in applying the system to ordinary existing tramways, as in constructing a conduit outside the track but little interference with the traffic would be necessary. The facility with which the collecting arm can be removed renders it easy to use this system in continuation of an overhead line.

The following special advantages are claimed for this system as compared with any other conduit system :—

(1) Immunity from danger ; all the electrical apparatus being so situated as to render it impossible for contact to be made therewith except by the collector.

(2) Cheapness in construction, and simplicity in working and renewal.

(3) The most perfect form of insulation, as with a flexible conductor the supports can be at long intervals, and need therefore only be provided at hatchways, permitting of the use of oil insulators.

(4) The employment of a rigid arm, without springs or other devices, to carry the collector : thus completely obviating any risk of the collector coming into contact with the roof or walls of the conduit.

(5) The facility with which any portion of the electric fittings can be laid, removed or renewed, the conductor being dropped into position or removed through the slot, and the insulators and their attachments through the hatchways. The collector shank can also be withdrawn through the slot, and the collector proper through any hatchway.

(6) The absence of any obstruction whatever in the tube underneath the slot, thus permitting a sweeper being attached to a car for the purpose of cleaning out the conduit when required.

(7) The absence of all points or crossings on the conductor.

(8) The applicability of the system to any known means of distributing electricity from a central station, whether in parallel or in series or employing one or two conductors.

(9) The facilities given for using this system in conjunction with a system where overhead conductors are used.

LIGHTNING ARRESTERS.*

(FROM A CORRESPONDENT.)

IT has often occurred to me that, in this age of rapid invention, too much credit is given to the adapter, while the merits of the discoverer are almost entirely overlooked.

From a remark of Prof. Oliver Lodge's, in his recent lecture on "Lightning Guards for Telegraphic Purposes, &c.," I think it would be worth while to remind your readers of some historical facts in connection with this instrument.

The three fundamental principles employed in the construction of all modern lightning protectors are :—

1. The sparking of high tension electricity from one metal plate to another, separated from it by a thin layer of insulating substance, or, indeed, of air itself.

2. The discharging of high tension electricity between adjacent metal points.

3. The fusibility of fine metal wire by high tension electricity.

Without going back to the original discoverers of these phenomena, let us see who first employed all or any of them.

Steinheil, in 1846, seems to have been the first to arrange a lightning protector. It consisted of two large metal plates, separated by a thin layer of silken material. Curiously enough, these plates were inserted in the line, but no connection made between them and earth. Lightning discharges, instead of being put out of harm's way, were thus only shunted off to the next station, affording a means of testing all protectors on the line. Meissner, however, in the same year, connected one plate with earth.

The so-called "Siemens's plate protector" is nothing but these original plates, with their inside surfaces lined and put together, so that the lines on the two plates cut one another at right angles, a modification which Mr. W. H. Preece, F.R.S., has shown to be of no practical value.

Breguet was probably the first to utilise the fusibility of fine metal wire, while Walker and Fardley combined both plates, fine wire and points, as early as 1847.

There were numerous other protectors containing one, or all of these principles ; and, indeed, just as now, every electrical novice arranges some special form of key, so most telegraph engineers have at some time arranged a lightning protector.

Bianchi's vacuum protector introduced a new feature, which, however, has not been much used. I do not know of any modern protector which materially differs from the old forms, if I except that due to Sir Charles Bright, which is an ingenious combination of points and fine wire remaining in perfect working order, even after a succession of discharges have passed. This, perhaps, is scarcely modern, and was probably contemporaneous with Walker's and with Fardley's.

Another instrument, possessing great merit, is that arranged by Prof. Andrew Jamieson.

* Our correspondent has evidently overlooked the work done by Varley in this field of research.

ALTERNATING TRANSFORMER SYSTEMS IN SOUTH AMERICA.

IN the REVIEW for May 2nd we referred to various transformer systems in South America. We again allude to one that has been erected in Santiago-del-Estero in the Argentine Republic, about 700 miles inland from Buenos Ayres.

The system employed is the "Lowrie-Hall," consisting of Lowrie-Hall converters and meters, and two 70-unit "Lowrie-Parker" alternating current dynamo machines.

The electrical plant was selected in England, and erected for a private company in the Argentine Republic by Mr. William Robinson, who has recently returned from that country.

The whole of the conductors distributing the electricity throughout the town are carried by means of overhead wires, suspended on tube or lattice arches, which span the streets.

A transformer is fixed above every lattice arch, to convert the pressure from 2,000 volts to 100. The secondary wires are then stretched along for the supply of street and private lighting.

The lamps for the public lighting are suspended either between the secondary leads or fixed on the arches. For private installations the current is supplied direct from the secondary leads or from the transformer placed on the roof or other convenient position.

The lattice arches were designed and constructed by Mr. Lowe, the company's engineer at Buenos Ayres, and forwarded in sections to Santiago-del-Estero.

The public lights are run from sunset to one o'clock in the morning, giving perfectly satisfactory results.

Personal. — On Thursday evening, May 1st, Mr. Arthur Greenwood, chief inspector of the Bradford District of the National Telephone Company, Limited, was presented by the staff with a testimonial and a present, in the shape of a handsome travelling bag, on the occasion of his leaving the district, as a token of the high esteem in which they held him.

ELECTRICAL LITIGATION IN BELGIUM.

JUDGMENT has just been given in the action of the Société Industrielle de l'Electricité against M. Beeckman, which we have already referred to in the ELECTRICAL REVIEW. The judgment, in substance, finds that the loss of 118,141 francs which the company alleged was caused by M. Beeckman's management was not established, that the errors of book-keeping set forth by M. Ithier, the book-keeping expert, could not be imputed to M. Beeckman, who occupied himself specially, in the council of management, with industrial negotiations, and who had charged his colleagues to see that the deeds were properly kept; that he could not be responsible for the errors of an *employé*; that consequently the demand tending to make him pay the expenses of a supplementary book-keeping was badly founded; that it was the same with regard to that part of the demand which tended to the restitution of the emoluments which he had received. The judgment declares that the expenses, to the extent of 6,739 francs, the restitution of which was claimed by the company, were justified. As to the projectors, it was decided that M. Beeckman had opened an account in the books of the company in the matter, and that the profits on the single projector sold had been handed to the company. Consequently, the defendant having offered to give the company all the information relative to the projector business and all other business the Court over-ruled the company's action, and, recognising that the company was in M. Beeckman's debt, ordered it to pay him 6,460 francs, and further ordered the suppression of the following sentence :—"The balance sheet for 1888 was inaccurate." The company was also ordered to pay costs.

LEGAL.

Appeal from the Birmingham County Court.—In the Queen's Bench, London, on Thursday in last week, the appeal in the case of Chamberlain and another *v.* Cadogan Electric Lighting Company came on for hearing before Baron Huddleston and Mr. Justice Grantham, sitting in a Divisional Court. Mr. Hugo Young was the counsel for the plaintiffs; the defendant company were represented by Mr. Ruegg.

Mr. RUEGG stated that this was the defendants application from the decision of the County Court Judge at Birmingham, by which he had found a verdict for the plaintiffs for £31, the amount of the claim, and also on a counter-claim for £25. The defendants did not appeal as to the judgment on the counter-claim, and only contested the decision as to the claim. The action was for the price of goods sold, which consisted of two electric meters.

The defence was that the meters were useless for the purpose for which they were supplied, and there was an express warranty that they were reasonably adopted for registering electricity.

In substance the judge found in favour of the defendants on the facts that the meters were not reasonably adopted for the purpose of registering electricity, but he held that in law upon the correspondence there was no express warranty, and that under the circumstances the usual implied warranty that the manufacturer who supplied an article for a given purpose warranted that it was reasonably fit for that purpose did not apply.

Mr. Baron HUDDLESTON: Why?

Mr. RUEGG said the ground was that the meters were a well-known trade article—Hookham's patent meter—and that defendants got what they asked for.

The defendants contended that the judge was wrong on both points. He said there was no express warranty contained in the correspondence, and there was the usual implied warranty.

Mr. HUGO YOUNG urged that the plaintiffs had never guaranteed the meters in any way, and that the defendants took them knowing that no absolutely perfect meter for the purpose of measuring electricity had ever been invented.

Their LORDSHIPS held there was plenty of evidence of an express warranty, and directed judgment to be entered for the defendants.

Appeal allowed, with costs.

Electric Portable Battery and Gas Igniting Company, Limited.—Mr. Commissioner Kerr, in the City of London Court, heard on Monday the action brought by Mr. Charles Leigh Clarke, Manchester, to recover from the defendant, Mr. Gustav Binswanger, 71, Queen Victoria Street, £40, the balance of £60 alleged to be due in consideration for his services rendered to the defendant in bringing about the purchase of the Electric Portable Battery and Gas Igniting Company, Limited, from the official liquidator as a going concern.

Dr. RENTOUL, who appeared for the plaintiff, said he was the inventor and patentee of an electric portable battery and gas igniter, and in 1881 a limited company was formed to further the interests of the invention. The plaintiff became the managing director of the company, which in 1887 went into liquidation. Afterwards the defendant agreed that if the plaintiff would enable the defendant to purchase the company as a going concern from the liquidator, the defendant would give him a certain sum, which was not then fixed. The plaintiff did a great deal of work in connection with the matter, and which resulted finally in the defendant being able to purchase the company. A few months later, in March or April of last year, the defendant and the plaintiff had an interview in Manchester to fix the amount to be paid to the plaintiff under the agreement made a year before. In that interview the amount was fixed at £60.

Mr. Commissioner KERR questioned whether he had jurisdiction to try the issue, as the contract was made in Manchester, and he adjourned the case in order that the place of trial might be altered.

Robbery.—At Southwark Police Court on Saturday last Arthur Ulett, 28, an electrical engineer, was charged before Mr. Slade with being concerned with a man named Jefferies, already in custody, with stealing 429 ozs. of platinum, value £1,000, the property of the Brush Electric Light Company, Belvidere Road, Lambeth.

On Monday last, the 28th ult., a box in the storekeeper's room at the works of the company was discovered broken open and nearly 500 ozs. of platinum, estimated to be worth £1,000, was found to have been abstracted. The matter was placed in the hands of Inspector Harvey, of the L division, who succeeded in arresting on Thursday a man named Jefferies, who had disposed of a quantity of platinum for £85, and at whose lodgings in Hackney about 70 ozs. were found concealed. When Jefferies was searched a letter was found on him, which is alleged to be in the handwriting of the accused. The prisoner, who is in the prosecutor's employment, had access to the storeroom, and is believed by the police to have given the platinum to Jefferies to dispose of.

Mr. SLADE remanded the prisoner until Friday, when he will be brought up with Jefferies.

CENTRAL LONDON RAILWAY BILL.

LAST Tuesday the Select Committee of the House of Commons passed the preamble of the Bill, subject, however, to stringent provisoes; one, that nothing should relieve the company from liability to pay compensation under the Land Clauses Consolidation Act; that every opportunity be afforded the engineers of the City Corporation and the County Council for inspecting the works during progress of erection, to guard against possible damage to sewers, drains, or other public works. The final point, which may be a serious obstacle, is that the promoters shall not issue any prospectus, and raise no capital, until the City and Southwark Railway has been opened and used by the public for a considerable period. The Committee cannot be accused of the want of caution in this matter, and although not very satisfactory to the promoters, yet it seems, in the interest of the great majority, the wisest way of settling the matter. The following is a short description of the few last sittings of the Committee, which met for the ninth time on Thursday last, when, after Sir John Fowler had been recalled to give further evidence as to the estimates, the Hon. Alfred Lyttelton addressed the Committee on behalf of the Duke of Westminster, in opposition to the Bill; and after the Duke's architect and surveyor and other witnesses had given evidence bearing out the statement of counsel, Mr. Moorsom, Q.C., addressed the Committee on behalf of the owner of the Evelyn estate. At the tenth sitting, on Friday, the Committee were engaged in hearing the opposition of the London, Chatham and Dover Company, in whose behalf Mr. Pope, Q.C., said that the whole thing was a mere experiment, and that experiments should not be made on such streets as Oxford Street and Holborn.

Continuing the sitting on Monday, Mr. LITTLER, Q.C., addressed the Committee on behalf of the Corporation of the City of London. It appears the opposition of this body is that they consider the scheme somewhat premature, and there was a doubt as to whether the public would utilise the line to the extent which was expected. This argument seems to be very weak when one considers the total number of passengers carried on the Metropolitan system. As to the question of sub-soil, which the promoters consider they ought not to pay for, we are compelled to admit that Mr. Littler has good reason in arguing that the sub-soil belongs to the owners of the surface. Mr. Bell, the manager of the Metropolitan Railway, was an interesting witness, from whom a good opinion on the project was expected. He took an opposite view to Mr. Greathead, and considered that gentleman's figures very inaccurate. He had visited America to view the electric traction system there, and was not favourably impressed with it. He admitted that the matter of electric traction was discussed by his company's directors, but nothing had been done yet.

On Tuesday the sittings were resumed, and resulted, as we have before said, in the Committee's approval of the preamble of the Bill.

NOTES.

Electric Lighting at Brighton.—There was a somewhat lively discussion at the Brighton Town Council last Thursday week with reference to a proposal to invite tenders for carrying out the electric light works. It was proposed by the Lighting Committee that the consideration of the tenders should be adjourned until the decision of the Local Government Board had been received regarding the proposal to borrow the necessary funds. The inquiry was characterised as a farce, and it was moved that the report should be rejected; but the Town Clerk having stated that he had heard from his London agents that the Board of Trade would grant the order to the Brighton and Hove Electric Light Company in the event of the Council's application to the Local Government Board being refused, the report was adopted.

The Electric Light in Court.—The Fifth Chamber of the Civil Tribunal of the Seine, in the case of Barria against Duchemin, has decided in favour of the latter. M. Barria, who is tenant to M. Duchemin, is the owner of a café, and wanted to substitute electricity for gas lighting on the premises occupied by him, against the wishes of his landlord, and the fact that his lease expressly debars him from making alterations in the premises without the landlord's consent. A Parisian contemporary thinks the opponents of electric lighting will derive considerable encouragement from the above decision.

Lighting at Fareham.—A short time ago we referred to the formation of the Fareham Electric Light Company, Limited, having for its object the lighting of that town. Fareham is only a small town of about 15,000 inhabitants, but notwithstanding this the latter have come to the conclusion that the electric light is preferable to gas, and accordingly the local authorities have contracted with the electric light company for the public illumination of the town for five years at an annual sum of £500. The Laing, Wharton and Down Construction Syndicate (Thomson-Houston system), are about to fit up the central station. The plant will comprise a Ruston-Proctor boiler and engine, an alternating current dynamo and a continuous current machine. The public lighting will consist of 20 arc and 100 glow lamps, and will be inaugurated in September.

Re Chelmsford Lighting.—With reference to our note of last week culled from the *Gas World*, which says that Messrs. Crompton must have lost considerably by fines, we are informed by that firm that the statement is wholly inaccurate; they further state "that up to the present time they have had no intimation of any fines having been inflicted, neither do they expect any, nor has there been any such collapse of the lamps as would be supposed from the notice in the *Gas World*."

"Fin du Siècle."—M. Eiffel has made a proposition to the World's Fair Committee to erect a tower for the Columbian Exposition at least 1,500 feet high. The projected tower is said to be the joint enterprise of M. Eiffel and Thomas A. Edison. It is reported that Mr. Edison later intends to place a million ordinary incandescent lamps of various colours upon the structure, which, as an American exchange points out, would mean, in round numbers, twelve times as many lights as are used in the entire State of Massachusetts, and would require an expenditure of 100,000 horse-power to produce the necessary current.

Bumble on the War Path.—The New York Senate Committee on General Laws, having thoroughly investigated the question of possible accidents to overhead wires, is now directing its attention to electricity as a motive power for street cars, and its distribution for this purpose, with a view to recommending, if necessary, the appointment of a board of supervision for electric railways, steam and gas companies.

The "Molecular" Telephone.—Mr. H. H. Warner, of "Safe Cure" fame, and now part proprietor of the Shaver "Molecular" telephone, has issued no less than ten million circulars on the subject of his new venture. Mr. Warner ought to know the value of advertisement.

Information Asked.—Two points, says *Money*, will have to be considered when shares are offered in the company shortly to be brought out by the Electric Welding Syndicate with a capital of £460,000. First, why the patent rights are to be offered at £460,000, when the original American company was launched with only £300,000, especially as the scope for the process is greater in the States; and, secondly, how much, if any, will be handed over to Sir F. Bramwell for booming the process before the Institution of Civil Engineers and the Royal Society? A similar case of puffing, our contemporary believes, was done in the case of the Cowles's Aluminium Syndicate.

Ink-Photographic Portraits.—There is a capital portrait of Mr. R. E. Compton in the *Machinery Market and Exporter* for May 1st, together with a short sketch of his life. As the likeness is inserted as a special supplement, some of our readers might feel inclined to become possessors of such an excellent artistic production, journal included, for the low price of 6d.

Action for Damages against the Edison Electric Company.—New York, May 4th.—The Edison Electric Company has been served with the papers in a suit brought against it by the Ganz Electric Company of Buda Pest, damages being laid at half a million of dollars. The Ganz Company owns the patent of the alternate electric system, and it maintains that Mr. Edison, President of the Edison Electric Company, used influence with the Legislature of New York State, and induced them to adopt the alternate electric system for the execution of criminals, thereby prejudicing the public against the Ganz electric system. It was necessarily demonstrated that the Ganz system was sufficiently powerful to kill instantly, and ordinary consumers of electric light have in consequence become alarmed and prejudiced against it.

Cobalt for Nickel.—They talk in America of substituting cobaltage for nickelage. Cobalt salts are, it is true, much more costly than nickel, but it seems it is easier to get cobalt to stick. It is also whiter, much more sightly, and less difficult to polish. The deposit, in fine, is obtained by a much smaller expenditure of electrolytic energy.

Trees and Lightning.—A German scientist has discovered that trees, the trunks of which are covered with moss or lichen, are more liable to lightning strokes than others, and hence the comparative immunity of the oak.

Medal.—The Institution of Engineers and Shipbuilders in Scotland have awarded the Institution Medal to Prof. Jamieson for his paper on "The Designing of Continuous Current Alternating Dynamos."

Who is He?—Some opinions on the electric wire question in New York are quoted by the *Boston Journal of Commerce*, which credits them to "Prof. George, one of the most eminent of English electricians." We regret that we are unacquainted with the gentleman.

A Good Sign.—As a gratifying indication of the progress of electric lighting abroad, and of the fact that England is getting some share of the work, we may mention that one of the leading London firms has just placed an order with Messrs. Dorman and Smith, of Manchester and London, for a single consignment of five thousand of their standard patterns of combined porcelain switches and fuzes, besides other accessories for immediate shipment, the switches representing a capacity of over fifty thousand lamps.

Telephony at Caen.—The English Vice-Consul at Caen reports that the Administration of the Ponts et Chaussés have recommended that the telephone between Caen and Ouistréham, a distance of about 10 miles, should be opened for the use of the public, it having hitherto been retained exclusively for the use of that department.

Personal.—Mr. J. D. F. Andrews, who has lately made London his headquarters, has taken Mr. H. H. Gray, civil engineer, into partnership, and has removed his office to 41 and 42, Parliament Street, Westminster, where his business of electrical engineer will be continued, under the well-known name of J. D. F. Andrews and Co. The firm intends applying its energies especially in the direction of the equipment of electricity supply stations, in which Mr. Andrews has had long experience, in conjunction with his late partner in Glasgow. The other specialities of the firm relate particularly to Mr. Andrews's concentric wiring for electric lighting in building and ships, which was introduced into several installations on land, and upwards of 100 on steamers, and judging from the testimonials received by his firm, they have given perfect satisfaction. Mr. Andrews was the first to supply this mode of wiring for interior lighting, and has taken out several patents for recent improvements, especially in the joints and switches. We have received a circular setting forth the great advantages of the system, and we are promised a description of the details for publication at an early date. Messrs. Andrews and Co., we understand, have made special preparations for supplying the trade with their various specialities, and are about to issue their trade catalogue and price lists.

The Westinghouse Electric Railway.—The *Electrical World* says considerable interest is excited among electrical circles in the railway system that will soon be vigorously pushed by the Westinghouse Company. It is understood that the alternating current motor is to be used, and this alone is enough of a novelty to force the system into public notice. How well the alternating current motor will perform under the very severe conditions of street car service it is difficult to say, but it is certain that the subject has been carefully considered, and it is understood that the preliminary experiments have been encouraging. The real merits of an electric railway system can, however, only be determined after exhaustive trial in real service, and the performance of the first alternating motor road installed will be watched with the greatest interest. The new company starts with a powerful backing, and a determination to push, so that we may soon expect to see its system in actual operation.

The Institute of Medical Electricity, Limited.—Viscount Templetown has accepted the chairmanship of this institute in the place of Mr. Wm. Lant Carpenter, who, owing to ill-health, has resigned his office, to the great regret of all concerned. Lord Templetown is a well-known electrician, and has taken strong interest in the Institute of Medical Electricity since its inception. There is no doubt that under his rule the scientific thoroughness of the institute will be maintained and its usefulness further developed.

Electric Lighting in Paris.—The Maison Mildé has obtained from the Municipality the concession for lighting a section of the city between the Boulevard Malesherbes to the fortifications and the Seine. This includes the Champs Elysées, Passy and Auteuil quarters, some of the best in Paris. The works are to be completed within four years. Caution money to the extent of £12,000 is to be deposited by the contractors.

Cricket.—A match was played at West Drayton on Saturday last, between the Electrical Engineering Corporation, Limited, and the Acton Hill Electric Light Works, resulting in a victory for the latter.

India-Rubber in the United States.—The British Consul at Boston reports that the open winter of 1888–89 caused a large falling off in the demand for rubber goods, and the price for the raw material declined to a very low point. This reduced importations, which being followed by improved consumption, and the fear that the Brazilian revolution might affect future supplies, produced a reaction, and prices went up considerably, fine para, which had ranged from 2s. 10½d. to 3s. 1d., being quoted at 3s. to 3s. 5d.

French Telephone Statistics.—The French Minister of Commerce has published statistics showing that on the 1st April, 1890, there were 12,800 subscribers to the various telephone systems, distributed as follows:—Paris system, 7,445 subscribers; departmental systems taken over by the State, 2,630; old State systems, 2,725. On the 1st September, 1889, the date at which the State took possession of the lines, there were only 11,442 subscribers. This gives an increase of 1,538 subscribers in seven months.

Concert.—The next smoking concert of the Beaufort Club will be held on Saturday evening next, when the Duke of Beaufort will take the chair, and when the club-house will be illuminated for the first time by the electric light.

Admiralty Contracts.—The Lords of the Admiralty have placed contracts for projectors, search lamps, and switchboards with Mr. Ronald A. Scott, M.I.E.E., amounting to several thousand pounds.

The Royal Society.—Yesterday a paper was down for reading "On the Heating Effects of Electric Currents, No. 4," by Mr. W. H. Preece.

The Board of Trade and Electric Lighting Companies.—In the House of Commons on Thursday last week, Mr. Kimber asked the President of the Board of Trade whether, as the Board had struck out at the instance of local authorities clause 6 of the Board's model order prohibiting a supply of electricity beyond the area of supply, he was prepared to make a similar concession to electric lighting companies; and whether he would grant to companies the same concession—namely, an appeal to the Board of Trade in the matter of compulsory works, which the Board made to local authorities at their recent interview with the officials of the Board of Trade on April 24th last. Sir M. Hicks-Beach: My answer to the first enquiry must be in the negative, seeing that the position of a company limited to an area, and possibly with other companies in adjoining areas, is distinct from that of a local authority having jurisdiction over their own local district, even though this should be larger than their area of supply. As regards the second enquiry, I am prepared to treat companies and local authorities alike.

New Signal System for Railway Traffic.—Captain A. Frassinari, First Lieutenant Del Buono, and Commander J. Nigra, manager and proprietor of the electrotechnical establishment in Alessandria, have invented an electric signal system, the object of which is to ensure safety in railway traffic and to avoid collisions. The Italian Minister of War has invited the inventors to Rome in order to test the system, and the Minister of Public Works is expected to help in the trials.

Tampering with an Electric Circuit.—One night last week some mischievous person or persons—of course, unknown—tampered with the main circuit by which the Brush Electrical Company is supplying Bournemouth with the electric light. All the lights supplied by the company were temporarily extinguished. In view of the alarm and confusion which the incident occasioned, the company will take strong measures with the view of preventing its repetition.

The Electro-Harmonic Society.—The balance sheet of this society shows it to be in a flourishing condition, and doubtless next season the committee will be enabled to set before the members programmes of a still higher class. There are no fewer than 278 subscribers to the society, with 11 more names down for election; probably the commencement of the 1890–91 season will see the number increased to 300.

Telephonic Extension in Scotland.—The National Telephone Company has just completed the erection of new wires between Glasgow and Edinburgh. Previous to the latter being brought into daily use, an opportunity to speak over them was afforded last Friday to the representatives of the press in Dundee and the local representatives of the press in Glasgow, Edinburgh and Aberdeen. Through connection with the Glasgow Telephonic Exchange having been secured, conversation was carried on with various gentlemen there; and next, the necessary connections having been made, conversation was carried on with Sir W. Thomson at the Glasgow University. The speakers at both ends of the wire were quite distinctly heard, all speaking in the ordinary conversational tone of voice. Communication was afterwards carried on with gentlemen in the Edinburgh exchange, and the results were equally satisfactory.

Important Sale by Auction.—Messrs. Wheatley Kirk, Price and Goulty announce a five days' sale, commencing on Tuesday, 13th, at the Gateshead Ironworks. The catalogue includes rolling mill plant, machine tools, Siemens-Martin steel furnaces and gas producers, engines and boilers, cranes, iron-framed rolling mill sheds, and miscellaneous loose plant.

The Royal Military Exhibition.—This exhibition, which was opened on Wednesday by the Prince of Wales, is likely to prove the most popular out-door resort of the present season in London. An important feature is a band-stand, said to be the finest in Europe, and providing accommodation for 500 performers selected from the best solo players in all the military bands available. Both buildings and grounds are brilliantly illuminated with the electric light. The lamps are Thomson-Houston arcs, fed from Thomson-Houston dynamos driven by Davey Paxman engines.

Utilising the "Ancients."—An American company claims to have become possessed of the secret by which the ancients tempered the copper used by them for their tools, &c.

Society of Arts.—At the ordinary meeting to be held on Wednesday next, at 8 p.m., a paper will be given on "Prof. Elihu Thomson's Electro-Magnetic Induction Experiments," by Dr. J. A. Fleming, M.A.

Contracts made by Telephone.—An American judge in a recent case held that "contracts by telephone, when proven, are as binding as any other contract, but the practical difficulty lies in the uncertainty of proof," and so say all of us.

Lighting of New York City.—According to a published statement, it will cost the New York companies 11·2 cents more per lamp per night to operate their circuits underground that it did to furnish current from the overhead wires.

Electric Bells.—Tenders are asked for the supply and erection of electric bells at the fire-engine station and in 11 firemen's dwellings adjoining, in Suffield Street, Middleton, for the Middleton Corporation. Further particulars may be obtained on applicatian to the Borough Surveyor.

Stores.—The South Indian Railway Company requires a supply of telegraph stores and sundries. Specifications and forms of tender may be obtained at the company's offices.

Death of Mr. James Nasmyth.—Mr. James Nasmyth, the inventor of the steam hammer, died on Wednesday at Bailey's Hotel, South Kensington, aged 82. In 1834 Nasmyth commenced business in Manchester. Subsequently he removed to Patricroft, four miles from the city, where an extensive series of workshops soon arose. There the requirement of the Great Western Railway of a hammer capable of forging a wrought iron shaft 30 inches in diameter, led to the invention of the steam hammer which bears Mr. Nasmyth's name. Since his retirement from business life, at the age of 48, he devoted much time to astronomy, and his monograph on the moon, in preparing which he collaborated with Dr. Carpenter, of Greenwich Observatory, is the most valuable English work on the subject.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Brush Electrical Engineering Company, Limited.—An agreement of 23rd ult., filed on the 1st inst., between the Australasian Electric Light, Power and Storage Company, Limited, in liquidation, and this company, provides for the purchase by this company of certain patents in excess of those mentioned in the agreement of 23rd October. The consideration is 800 fully-paid £2 preference shares, and 800 fully-paid ordinary shares of £3 each, in the present company.

Electric Date and Time Stamp Company, Limited.—The annual return of this company, made up to the 2nd May, 1889, was filed on the 30th ult. The nominal capital is £100,000 in £1 shares. 2,343 shares are taken up, and 15s. per share has been called thereupon. The calls paid amount to £1,170 10s., and unpaid to £586 15s.

Institute of Medical Electricity, Limited.—The annual return of this company, made up to the 26th February, was filed on the 13th March. The nominal capital is £20,000 in £1 shares. 3,952 shares are taken up, 1,925 being considered fully paid. Upon 1,447 shares the full amount has been called, and upon 580 shares 15s. per share has been called. The calls paid amount to £1,766 15s., and unpaid to £115 5s.

An agreement of 29th ult. (filed on the 1st inst.), between this company and its managing director, Mr. H. Newman Lawrence, provides for the allotment to the latter of 100 fully paid shares of £1 each in satisfaction of a portion of his salary for the year ending 25th March, 1889.

Ward Electrical Car Company, Limited.—The registered office of this company, formerly at 9, Warwick Street, Regent Street, is now situate at 38, Gracechurch Street.

Kensington and Knightsbridge Electric Lighting Company, Limited.—The registered office of this company is now situate at 148, Brompton Road, S.W.

Kensington Court Electric Lighting Company, Limited.—The registered office is now situate at 148, Brompton Road, S.W.

NEW COMPANIES REGISTERED.

Electric Welding Company, Limited.—Capital £460,000, in £10 shares. Objects: To acquire inventions relating to the utilisation and employment of electricity for the purpose of welding, soldering, forging and working metals and other substances, and to the production, transmission, distribution and employment of electricity. An unregistered agreement with E. Fitzmaurice Lenon will be adopted. Signatories (with 1 share each): T. Willerson, 7, Nightingale Road, Clapton; W. Glynn, 14, Little Albany Street, Regent's

Park; J. Kayler, 26, Ranelagh Terrace, Leytonstone; R. Gordon, New Malden, Surrey, secretary to a company; Hy. Tipple, 44, Elmsdale Road, Walthamstow; Wm. Doherty, 6, Great Newport Street, W.C.; W. H. Adams, 168, Friern Road, East Dulwich. The subscribers are to appoint the first directors. Qualification, £500 in shares. The company, in general meeting, will determine remuneration. Registered 1st inst. by Ashurst Morris, Crisp & Co., 6, Old Jewry.

Thorneburry Miners' Safety Lamp Company, Limited.—Capital £50,000, in £1 shares. Objects: To carry on business as lamp manufacturers, electric and general engineers, and to purchase certain patent rights of James Thorne. Signatories (with 1 share each): J. V. Turner, M.E., 118, St. John's Road, Lewisham; W. J. Hammond, Red Post Lane, Upton Park; L. Brigden, Crown Hill, Norwood; R. J. Danter, 30, Bishop's Road, Brixton; J. Harper, 38, Bishopsgate Street; E. B. Burr, C.E., 85, Gracechurch Street; R. Davey, 24, Upper Kyverdale Road, Stamford Hill. The signatories are to appoint the first directors. Qualification for subsequent directors, 500 shares. Remuneration at the rate of £100 per annum, and in addition, 10 per cent. of the surplus profits, after payment of £10 per cent. dividend. Registered 5th inst. by Nash, Field and Withers, 12, Queen Street, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

THE MAXIM-WESTON ELECTRIC COMPANY, LIMITED.—What a terrible confession of incompetency is the report of the directors of this company just recently issued. From bad to worse, through reconstructions, reorganisations and fresh issues of capital, this fateful company has continued its downward path. Directors went and others came, but still the unfortunate course of events changed not. That a loss of £1,019 can have been made on the small amount of work undertaken seems quite incredible, the rent and taxes notwithstanding, and when this sum has added to it the directors' fees and office expenses, &c., the *loss* on eleven and a half months' working assumes the important likeness of £3,332. There is, and has been for some time past, no doubt in our minds that the only course open for the shareholders is to bring about the liquidation of the company. In Mr. Swabey's early days of office it was patent to us, and we see no reason to alter our opinion now. A financial contemporary in an article on this subject says, "It must be either that its patents are of no value, or that the management is altogether bad." Perhaps our contemporary would have been nearer the mark if, instead of the word "or," it had used the word "and," at the same time omitting the word "either." We know of no patent of this company which at the present time can be considered valuable, and as for the management, it has, we think, condemned itself irretrievably. Were it not that the whole matter is so hopeless, we would ask of the auditors—who, by the way, are, we believe, the accountants also of the company—some pertinent questions respecting the assets, but no good can come of such queries or of answers to them; there is nothing possible but to sell the skin and horns and bury the carcase as decently as may be.

Maxim-Weston Electric Company, Limited.

THE report of the directors, to be presented at the ordinary general meeting of the company, to be held at the Cannon Street Hotel, to-day, states that the directors beg to submit the accounts made up to 31st December, 1889, together with the auditors' report. The directors have delayed calling the shareholders together in anticipation of being able to report the result of the action against the managing director of the late company. That action is, however, still pending. The directors, in consequence, are unable to comment upon matters which are still the subject of litigation, and refrain from now giving to the shareholders so full an explanation of the position of the company as they would wish. The directors share in the regret which must be felt by every member of the company at the result of the company's operations.

The two directors retiring, under the articles of association, are Messrs. John Marks and James G. Couchman.

The auditors, Messrs. Boyce and Ramsay, retire in accordance with the articles of association, and offer themselves for re-election.

The profit and loss account from January 17th to December 31st, 1889, is as follows:—To loss on works, £1,019 15s. 9d.; directors' fees, £458 6s. 7d.; salaries of managers, secretary and clerks, £898 17s. 6d.; rent of offices, £112 10s.; stationery and printing, £161 3s. 2d.; advertising, £57 5s. 3d.; insurance, £69 6s. 6d.; travelling expenses, £191 1s. 11d.; patent fees, £41; legal and professional charges, £315 5s. 7d.; sundries, £49 4s. 6d.; total, £3,373 16s. 9d. By transfer fees, £39 16s. 6d.; interest, £1 16s. 6d.; balance carried down, £3,332 3s. 9d.; total, £3,373 16s. 9d.

The balance-sheet, 31st December, 1889, consists of—

Liabilities.—To subscribed capital, 268,755 shares of 3s. each, less calls in arrear (£4 15s.), £40,308 10s.; amount paid on 5,826 shares forfeited, £720 17s. 6d.; balance of purchase price unpaid, represented by 2s. per share on 37,419 shares unallotted—deduct amount paid to dissentient shareholders, 24,183 shares at 1s. 6d. (£1,813 14s. 6d.), (£1,928 3s. 6d.); add amount realised on sale by liquidators of previous company of 12,045 shares (£872 12s. 6d.), £2,800 16s.; reserve fund,* £1,939 9s. 3d.; sundry creditors, £2,390 18s.; total, £48,160 10s. 9d.

Assets.—By plant and machinery,* £2,182 0s. 3d.; stock,* £4,735 0s. 1d.; furniture and fittings, £426 19s.; stock of stationery, £10; patents,* £26,500; book debts of previous company unrealised,* £4,940 13s. 6d.; sundry debtors, including cost of installation, £1,582 12s.; cash at bank and in hand, £4,451 2s. 2d.; balance of profit and loss account, £3,332 3s. 9d.; total, £48,160 10s. 9d.

* See auditors' report.

AUDITORS' REPORT.

We have examined the accounts of the company for the period from the 17th January, 1889, to 31st December, 1889, and compared the accompanying balance-sheet with the books, and beg to report as follows:—

The plant, machinery and stock have been valued at the same prices at which they were taken over from the previous company. Nothing has been allowed for depreciation.

The patents are put down at £26,500. This is the nominal amount which they cost the company, such amount representing the difference between the estimated value of the assets and liabilities of the previous company at the date of the transfer.

We are informed that many of the patents had been allowed to lapse prior to the formation of the present company, and that a law suit is pending with regard thereto.

The book debts of the previous company, unrealised, amounting to £4,940 13s. 6d., include goods in the hands of agents abroad, and cash deposited in the bank and in Court, pending the result of the Watt actions. Of this amount only a small proportion can be considered good.

A reserve fund was created at the date of the transfer to the present company, to cover any deficiency that might arise on the realisation of the previous company's assets and the costs of reconstruction. To this account have been charged all losses upon the realisation of such of the book debts as had been settled up to 31st December, 1889, the costs of reconstruction, claims upon the previous company paid, and £157 10s. voted by the shareholders as the remuneration of the liquidators. The balance of £1,939 9s. 3d. remaining to the credit of the reserve fund is not sufficient to meet the deficiency upon the remaining book debts of the previous company, and the costs of pending law suits.

Subject to the above observations the balance-sheet sets forth the position of the company's affairs as shown by the books on the 31st December, 1889.

BOYCE & RAMSAY,
Chartered Accountants, Auditors.

2, Metal Exchange Buildings, E.C.,
April 28th, 1890.

The West India and Panama Telegraph Company.

THE twenty-sixth ordinary general meeting of the shareholders was held at Winchester House on Wednesday last, Mr. C. W. Earle in the chair, to receive the report and accounts for the six months ending December 31st, 1889, copy of which appeared in our last issue.

The Chairman felt bound to confess that the report caused him some disappointment. He did not allude to any falling off of traffic, because in that respect it compared favourably with the very largely increased traffic of the corresponding period of last year, which also showed considerable increase upon the previous corresponding one. He referred to the increased expenditure for repairs. This time last year he had expressed the conclusion that the large expenditure made in putting down new cable, and the experience gained of the seas in which the company's cables lay, would keep down the expenditure under this head. It was disappointing, therefore, that that expenditure had in this half-year rather exceeded the average. At their last meeting the directors had been urged to do away with, if possible, one of the two repairing ships. The experience of the past half-year would convince them, he thought, that it was impossible to foretell what might happen. Up to the month of September only four interruptions occurred, but on the 2nd December the Jamaica-Porto Rico cable was interrupted;

on the 6th December the St. Thomas-St. Juan was interrupted, and on the same date the same thing happened to the Jamaica-St. Juan. On the 13th of the same month the St. Vincent-Grenada, and on the 17th the Trinidad-Demerara were interrupted; on the 18th the Martinique and Sta. Lucia was interrupted. With all this, the only colonies cut off from telegraphic communication had been Sta. Lucia, St. Vincent and Barbados for one day, and the colony of Demerara for fourteen. The rapidity with which the repairs were made reflected great credit upon the captains and crews of the repairing vessels; but it was a very serious lesson, as showing how impossible it would have been to have done with only one ship. The fact of those repairs having made it necessary to put down no less than 77 miles of cable, relieved them from the necessity of adding to the reserve fund. The colonies of Barbados and Demerara were two of their principal customers; they only had single cables, and, unfortunately for the company, occupied a terminal position. The frequent interruptions in their cables caused them considerable dissatisfaction; they immediately stopped the subsidy to the cable interrupted, and, of course, a good deal of traffic was put a stop to, although sloops were put on to carry messages and keep up communication as far as possible. The result was that the company had offered to extend to those colonies the advantage of a duplicate cable on their assuring the company of their subsidies for a period of ten years. Their offer had been virtually accepted by the local legislatures. A French company had recently laid down a cable between the French colonies of Martinique and Guadaloupe, which formerly paid the company a subsidy of £2,000 a-year each. The company's contract with Martinique expired at the close of last year; that with Guadaloupe would expire shortly. At the commencement of the year the company made a new contract with Martinique, which subsequently revoked it at the instance of the French Government, after the company had performed its part of it for three months, and with a stroke of the pen deprived the company of its subsidy for commencing its services. He only wished the English Government and colonies would show a like preference for English enterprise. With reference to the International Telegraphic Conventions, he stated that the directors had resolved on this occasion to depart from the usual practice of having the company represented by outsiders, and that he himself would represent the company at the Convention. They had been impelled to this course by the circumstances of the French competition referred to above, and also by the fact of the Spanish colonies having joined the Convention. He observed that it went rather against the grain to pass six weeks at a hotel in Paris, and he hinted at an early relinquishment of the duties of chairman of the company. He then moved the adoption of the report and accounts, and the payment of 6s. per share upon the first preference shares for the six months up to December, 1889, and one of 27s. 6d. on account of arrears on the second preference shares for the same period.

In reply to a shareholder, the chairman stated that the company's extent of submarine cable amounted to 4,000 miles; to another he said there was nearly £20,900 still due to the second preference shareholders; to another that the interest on the depreciation fund was added to that fund, and not to general revenue; and to another shareholder that the lengths of cable they proposed duplicating amounted to 100 miles and 300 miles respectively. Asked whether the directors contemplated litigation with the French company, he replied that they would do nothing that would involve the company in useless litigation. He further stated that the expenditure upon ships and cables in the last year had been very little in excess of the normal expenditure during the previous fifteen years.

The motion was then put and carried; Sir James Anderson and Mr. William Andrews were reappointed directors, and Mr. Jno. G. Griffiths, F.C.A., auditor, and the meeting broke up with a vote of thanks to the chairman and directors.

House-to-House Electric Supply Company, Limited.

THE second annual meeting of this company was held at the works, West Brompton, on Monday last, Mr. Hy. Ramié Beeton in the chair.

The Secretary read the notice convening the meeting.

The Chairman: The first observation which I have to make in regard to the accounts is that in the early stages of our business the capital expenditure is necessarily out of proportion to the earning capacity, and for this reason. We are called upon to meet, in the nature of the case, a progressive demand; and the form of supply which is most economical in the case of a large demand is different to the one which is most economical in the case of a smaller one, so that we are practically obliged, in the first instance, to adopt a capital basis which is adapted to an ulterior rather than to an immediate revenue. This being so, the justification of our accounts is to be sought at a point more or less removed. We must be content to-day if we are in a position to predicate with certainty that the course of our profits will be such as to permit a reasonable dividend in the near future, with the assurance of an improvement later on. Now, our present plant is equal to the supply of twice as many lights, and our capital capacity is equal to the supply of three times as many lights as we have on our existing circuit; and this notwithstanding the fact that we have connected, on an average, about a thousand lights per month. I think that these figures are evidence that our progress up to the present has been satisfactory, and I think, also, that we may look forward to a steady progress in the future. It is always dangerous to prophesy, and never more so than in the case of a new industry, in which the conditions are without precedent, and in which a very limited experience is available to guide us; but I can say with some degree of confidence that if the rate of progress which has prevailed in the past is maintained in the future, that in twelve months from to-day we shall be in the enjoyment of a demand which will ensure us a fair dividend on our capital, and in two years from the present time our profits would be as much as it would ever be prudent to distribute. We could have wished that our progress had been greater than it has been; but even in a rich residential district like ours, we find that there are many causes which operate to deter custom. In the first place, it is our peculiar misfortune that we have to suffer, instead of benefiting, by the faults of those who are engaged in the same line of business. It is unfortunately true that whereas we ourselves have never had a failure of the lights, yet the fact that some of the other supply companies have notoriously blundered has deterred many people, even in our district, from becoming customers. They naturally hold off until they can feel more assurance of continuous and reliable lighting. Then, again, we have to contend with the expense of installing the light, which, of course, operates with added force during the lifetime of existing gas-fittings, and during the unexpired portion of short leases; and lastly, we have been prejudiced by an unfounded scare, which has been fostered by interested and unscrupulous persons, of the danger of the current. But, notwithstanding these obstacles, we have confidence in the future of electric lighting. The electric light is healthful, and it is clean, and these are advantages which many can afford to pay for, and which, when an increased demand, has enabled us to reduce the cost of production, we hope to bring within the reach of more. As an indication of the confidence which is felt by our neighbours in our future, I may mention that, so far as we are aware, every new building in the district is being wired for the electric light, and no gas-pipes are being admitted at all. Moreover, we are not only in a position to supply both arc and incandescent lighting, but also motive power; and already we have been asked to provide for this class of customer among the business premises which we serve. I am afraid some of the shareholders have felt that the attendance here to-day has been somewhat inconvenient, but the directors felt that it would be an advantage, and, perhaps, a compensating advantage, that they should be able to visit the district and inspect the station. Whatever anybody else may say about us, I think everyone will recognise the excellence of our station; and, after all, mechanical efficiency is the foundation of prosperity in every business. Our dynamos, which I hope you will soon see, are working now, as they always have done, noiselessly, and with a minimum of supervision, and they have never had any repairs; and, indeed, no work has been spent on them whatever since they have been started. The excellence of our work, and the unrivalled experience of our engineers, have induced us not only to anticipate success in the field of supply, but also to look forward to building for others similar stations to that which we have built for ourselves. We believe that those who are engaged in overcoming the daily difficulties of supply, and who are called upon to meet thr constantly varying conditions of the industry are best qualified to undertake the work of construction, that no engineer, whatever his theoretical experience, and that no construction company, however extensive its work and resources, can compete in the knowledge which is necessary to the successful establishment of a central station with those who, like the engineers of the House to House Company, have been engaged in planning and constructing the earliest and most successful stations, and in conducting their operations ever since. Possessed of these qualifications, and encouraged by the action of the Board of Trade in allotting the metropolitan area, we have formed provincial companies with a view to developing electric lighting generally and promoting the system and interests of the House to House Company in particular in those cities and towns in the United Kingdom. To this end we have appointed qualified agents who have visited our stations, who have acquired a knowledge of the industry, and who have formed confidence in us. These agents, acting on behalf of such companies, have sought the permission of the local authorities in all the principal centres to apply for statutory powers, and in so doing they have neglected no opportunity of bringing the merits of our station under the notice of deputations from the local authorities. We hope and believe that the expenditure which we have incurred in this direction will bear good fruit, and in support of this expectation I may mention that we have already obtained the requisite sanction of many local authorities, and in other cases where such sanction has been withheld, we believe that if the local authority undertake the lighting themselves we shall obtain the work of erection of their station, and if they neglect to apply for statutory privilege we have the assurance of the Board of Trade that any application for provisional order which we ourselves may make, due regard will be had to the fact that we have been at considerable expense, and that we have complied with the rules of the department. With the growth of this branch of our business, the directors are of opinion that it will be desirable to separate the supply on the one hand from engineering or construction on the other, and they have had several plans under consideration to this end which, when the time comes, they will submit to the shareholders; and with these few observations I move, "That the report and accounts be received and adopted."

Mr. Robert Hammond, in seconding the resolution, said he felt that, after the exhaustive speech of the chairman, there was little to be added; but he should like to draw the attention of

the shareholders to one or two points in the report, and to emphasise them; the first was that they had only for a very short time been in possession of Parliamentary powers. It was true that the company was formed two years ago, but it very soon became apparent, with the very stringent rules which the Board of Trade put forward in regard to overhead wires, that the company's system must be by underground wires, and though they made application to the vestry in June, 1888, various forms had to be gone through before they could finally get—what they have got—an Act of Parliament. Practically, they did not start until November last, and he was inclined to take a more sanguine view of the progress made than the chairman had put forward. He considered it would be absurd, at the beginning of a 42 years' tenure, to judge of their future business by the few paces that they had made upon it. They would see, if they glanced at the map to which the speaker referred, the growth of the undertaking since November. Having arrived at the state of things by which they could claim that they had got a revenue which covered all working expenses and establishment charges, they had done exceedingly well after six months' work, and at the outset of a career which would last 42 years. He thought the plans referred to shewed very material progress, and he felt that at the end of a year the present works would not be sufficient to cope with the demand, and, as foreshadowed in the report, they would, as business increased, be obliged to increase machinery. Going back to the formation of the company, he would point out to the shareholders that the directors had fully carried out the programme laid down. The company was formed for the purpose of founding supply stations; it was not established, as most electrical light companies were, for the purchase of patents, that was carefully avoided, and the money asked for had been used for founding stations. By the sample work done, they had prepared the ground for a number of sub companies, which he trusted would be subscribed for in the various districts, and bring them increased business. He drew attention to the fact that not a single director had received any fees since the establishment of the company That seemed to him to say that the best interests of the company were in the hands of the directors. In conclusion, he looked forward with a great deal of confidence to the future, and had much pleasure in seconding the resolution, which was carried unanimously.

Mr. Beeton and Mr. Hammond were re-elected directors, and also the auditors, Messrs. Theobald Bros. and Miall.

A vote of thanks to the chairman concluded the meeting.

The Great Northern Telegraph Company of Copenhagen.

WE have been supplied by the company with the following abridged report of the general meeting held at Copenhagen on the 26th of April, 1890, M. F. Zahle, presiding.

The Chairman, C. F. Tietgen, Esq., in accounting for the working of the company during the year 1889, first referred to the state of the company's cables, which, unfortunately, had left much to be desired during that period, particularly in Europe, where the cases of interruptions had numbered 19. Of this number 15 had fallen upon the three cables in the southerly section of the North Sea, the most southerly cable being that which connects France with Denmark, whilst the two others connect England with Denmark and Sweden. Nearly all these breakages had been caused by the trawl fishing apparatus, which is still allowed to damage the cables with impunity, as the international legislation for the protection of submarine cables had not yet been extended to a control of fishing appliances. This regrettable fact had already been mentioned at the Conference held in 1883. The effects of the circumstances referred to, in addition to the constantly increasing traffic, would render it necessary for the company to lay two new cables in the North Sea, one between France and Denmark, in order to duplicate the Calais-Fanoe cable, the only one of the company's cables which had not yet been duplicated; and the other between England and Sweden, in order to ensure the transmission of the traffic between England and the north of Europe in the most efficient manner. Preliminary negotiations with regard to this subject had already been progressing, and the company would do its best to accelerate the realisation of its projects, more particularly as, during the early part of the year 1890, frequent interruptions had also occurred. In the Far East, the interruptions of the cables had been less frequent, the number having amounted to seven, none of which had interfered sensibly with the regular transmission of the traffic. In Europe, the company's cable steamer, the *H. C. Orsted*, had been in activity for 165 days during the year, and in the Far East the *Store Nordiske* had been altogether on active service for 171 days. The working of the lines had throughout been very satisfactory. Thanks to the efforts of the Russian Telegraph Administration, and to the introduction into Siberia of the Wheatstone system, the traffic between Europe and the Far East, transmitted by the Wladiwostock route, had been carried with a regularity, speed and correctness which had left little to be desired. The traffic revenue had reached about the same amount as the company earned in the good years of 1884 and 1885, before the tariff reductions introduced at the Conference of Berlin came into force. The company's position in China had not changed since last year's meeting. At the invitation of the Russian and Chinese authorities the company had, during two months last autumn, discussed the modifications desired to be introduced into the projected convention, which was signed at Chefoo in 1887; but notwithstanding the fact that the company had acquiesced in all the demands of the said authorities, new obstacles to the final conclusion of the affair had arisen. They did not yet know the nature of those obstacles, for which reason they would prefer not to formulate any opinion as to the chances of arriving at a satisfactory solution. The company had acquired in Copenhagen a building site, situated at No. 26, Kongens Nytorv, and adjoining their present offices, for the purpose of erecting a building where the administration, as well as the mechanical workshops of the company could be located in a more practical manner than at present, and notably less subject to the danger of fire. This measure had become a necessity on account of the development of the administration and the large increase of the archives during the progress made by the company in the course of the last 20 years, they had been in existence. The building operations had already commenced, and it would thus be explained that a somewhat larger amount than usually had been carried forward in order to meet the current expenses under this head. A rather larger amount than usual had been withdrawn from this fund in order to defray the expense of 100 nautical miles of spare cable, to be employed in strengthening the cables in Europe. The laying of the two new projected cables already referred to would absorb, in the current year, another important amount from the reserve fund; probably, including everything, not far from £200,000. It would, therefore, have been imprudent to add less to the fund than the same amount as in previous years, the more so as they were on the eve of an international telegraph conference, the decisions of which might possibly affect the revenue of the company, as had happened before at the telegraph conference held at Berlin in 1885. This time the conference would be held in Paris, and would be opened on the 15th May next. All the administrations of the different States, as well as the representatives of the private telegraph companies, had been invited to take part therein. On the occasion the company would, as usually, be represented by the managing director.

The following resolutions were unanimously carried at the general meeting, to the effect:—

"That the report and balance sheet were adopted, and that discharge was given to the board of directors." "That the retiring directors, C. F. Tietgen, Esq., and Capt. E. Suenson, D.R.N., were re-elected as members of the board of directors." "That A. Berner, Esq., and S. Bille, Esq., were re-elected as auditors of the company."

Submarine Cables' Trust.

THE nineteenth ordinary annual meeting of certificate holders was held at Winchester House on Wednesday last, noon, Sir John Pender presiding, when the following report of the trustees was laid before the meeting:—"The accounts for the financial year, to 15th April, 1890, are submitted herewith. The revenue for this period, including the balance of £165 1s. 6d., brought from the previous accounts, amounted to £23,259 6s. 10d. The coupon due on 15th October, 1888, was paid in two instalments, viz., £2 12s. 6d. on 15th April, 1889, and the balance of 7s. 6d. on 15th May last. The first payment of £2 12s. 6d. was included in the previous year's accounts, but the balance of 7s. 6d. was a charge against the revenue for the past year. The expenses of the trust amounted to £1,274 0s. 5d., and the payments on account of the coupons to £21,553 17s. 6d., together £22,827 17s. 11d., leaving a balance of £431 8s. 11d. to be carried forward. In addition to paying the 7s. 6d. outstanding on the October, 1888, coupons, the coupons due on April 15th and October 15th, 1889, have been met in full out of the revenue for the past year. The certificate holders have thus received interest at the rate of 6⅜ per cent. in the past year, as against 5⅝ in the previous year. The coupons due on April 15th, 1890, are in arrear, and will be paid as soon as the trustees have sufficient money in hand for the purpose. The trustees regret the loss sustained in October last by the death of Sir Daniel Gooch, Bart., who was connected with the trust since its formation. The trustees do not recommend that the vacancy thus occasioned in their number be filled up, the remaining trustees being quite competent to manage the trust. An appreciable saving in the expenses will thereby be effected. A table showing the original and present investments of the trust is appended to this report. The meeting will have to elect two auditors for the current year; Mr. John G. Griffiths and Mr. John Gane offer themselves for re-election."

After the usual formalities,

The Chairman said the accounts compared very favourably with those submitted at the last meeting. The revenue amounted to £23,094, as against £19,118 of the previous year, or an increase of £3,976. The expenses were £1,274, as against £1,383 last year, or a diminution of £109; the Trust, therefore, was some £4,000 better off. As stated in the report the certificate holders had received interest at the rate of 6⅜ths per cent. this year compared with 5⅝ths per cent. last year. The trustees hoped to continue to pay at the same or a higher rate until they had liquidated the coupons now in arrears, after which they would revert to the regular interest of 6 per cent., which, under the trust deed, was cumulative. As they were aware, the revenue of the company depended entirely upon the prosperity of other submarine companies, which were all at the present time working in harmony. There was no active competition, and consequently no cutting of rates. So long as the submarine companies worked in what he called this satisfactory and businesslike manner, the chances were that the shareholders would be large benefitters. This was just

one of those trusts whose income, more or less, fluctuated according to the prosperity of other companies. As he had often said, submarine telegraphy was becoming a necessity of the nations of the world. Those who used it could not give it up, and there was always a new crop of people coming up who found that to live in business they must use the telegraph. Therefore, seeing that their submarine system had touched every civilised part of the world, he believed that their Submarine Cables' Trust was one of those that would benefit materially from submarine progress and the extension of commerce throughout the world. He moved that the report and accounts of the trustees be adopted.

The Marquis of Tweeddale seconded the motion, which was agreed to.

Messrs. Jno. G. Griffiths, F.C.A., and Jno. Gane, F.C.A., were reappointed auditors at a salary of £25, and the meeting broke up with a vote of thanks to the chair.

Brazilian Submarine Telegraph Company.

THE thirty-third ordinary meeting of this company was held at Winchester House on Wednesday last, under the presidency of Right Hon. Viscount Monck.

The Secretary having read the notice convening the meeting,

The Chairman said he had nothing but congratulations to offer the shareholders on the state of affairs which the report and statement of accounts disclosed. During the half year they had paid a good dividend, they had largely increased the reserve fund, and a large portion of the first class debentures had been paid off. Altogether the income was coming in a very satisfactory manner. He might state incidentally that the income was coming in quite as well at the present time, they having received almost the same sum which was received last year for the same period. Under those circumstances he really had not much to say. He did not think the shareholders would object to a monotony, when it was a monotony of prosperity, and when the figures were always on the right side of the account. The only subject to which he would refer in addition to these matters, was that the accounts showed a slight increase in expenditure, partly due to the necessity for making new buildings for the accommodation of the staff in some of their tropical stations, and partly to legal expenses incurred in London. In conclusion, he referred to the competition to which they might be exposed when the concession concluded, which would be in 1892. They could not, of course, prevent the Brazilian Government or anyone else starting new lines to compete with theirs; all that could be done was to exercise the greatest supervision and care, and see when the time arrives that the company was in the best position to meet any competition which might arise. This matter constantly engaged their attention, and he trusted they would be able to overcome the difficulties. With these remarks he would propose the adoption of the report.

Mr. Youle seconded the resolution, which, after some remarks from shareholders, was adopted.

The West Coast of America Telegraph Company, Limited.

THE directors' annual report to be submitted to the meeting on May 14th states that the gross income of this company for the year ending 31st December, 1889, was £84,457 13s. 1d., against £65,714 15s. 4d. for the year ending 31st December, 1888.

Adding £480 3s. 9d. brought forward from previous year, makes £84,937 16s. 10d., and after deducting from this the debenture interest and all other charges, and the two dividends of 5s. each paid in July, 1889, and January, 1890, respectively, there remains the sum of £30,517 10s. 3d. Out of this amount the directors have transferred £25,000 to the reserve fund, bringing it up to £64,000, and recommend the distribution to the shareholders of 2s. per share as bonus, payable on May 21st, to write off £2,000 from the value of the repairing steamer *Retriever*, thereby reducing her valuation in the books of the company to £15,000, and leave £517 10s. 3d. to be carried forward.

The directors considered it prudent to add the above large sum to reserve owing to renewed threats of competitions, which, if carried out, would considerably diminish the revenue of the company.

The land line to Santiago, mentioned in last year's report, has proved a satisfactory investment.

The cables and repairing steamer are kept in perfect working order.

Mr. Henry Roberts and Mr. Frederick Walters are the directors retiring in rotation, both are eligible and offer themselves for re-election.

The auditor, Mr. J. Weise, of Messrs. Turquand, Youngs & Co, retires, and is eligible for re-election.

The Western and Brazilian Telegraph Company, Limited.

THE directors' report to be presented at the nineteenth ordinary general meeting of the company to-day states that the total earnings amount to £86,403 0s. 7d., as against £112,250 6s. 11d., showing a decrease of £25,847 6s. 4d. compared with the half year to December 31st, 1888. It will be observed that this decrease is much less than could have been expected when the shareholders met in November last; this is mainly owing to the greatly increased take during the last two months of the year, viz., November and December.

The working expenses amount to £40,391 11s. 9d., as against £31,220 4s. 2d., an increase of £9,171 7s. 7d.

Including the amount brought forward from June 30th, 1889, (£4,072 9s. 8d.) and the dividend received upon the shares held in the Platino Company, the balance to the credit of the revenue account is £57,462 18s. 6d., from which has been deducted £13,500 for debenture interest, £7,500 for the renewal fund and £5,600 for the debenture redemption fund. This leaves £30,862 18s. 6d. The directors now recommend the payment of a dividend of 6s. per share free of income tax on the ordinary shares for the half year, making with the dividend paid in November, £4 per cent. for the year, leaving a balance of £3,248 16s. 6d. to be carried forward.

Under abstracts A and C, "Expenses at stations and in London," the outlay is practically the same as for the corresponding period, which is a satisfactory feature considering the additional work done. In fact, out of the increased expenditure of £9,171 7s. 7d., £7,281 9s. 7d. is attributable to the necessity of chartering a cable steamer to fill the place of the *Norseman* called home for repairs; this was of course imperatively necessary for the protection of the revenues, and has already been approved by the shareholders. Of the remaining increase £928 14s. 11d. is for additional cable used in repairs; £78 15s. for auditors' fees and £809 11s. 1d. for increased amounts set aside for depreciation of company's ships. It will be remembered that the strikes at Leith delayed the repairs to the company's ss. *Norseman*, which increased the amount payable under charter. The *Norseman* returned to her station last November and the *Buccaneer* was immediately discharged.

In the case of shares which have been divided into preferred and deferred, 1s. 6d. per share of the dividend now recommended will be payable to the preferred shareholders, and 4s. 6d. per share to the deferred shareholders.

The first annual drawing of the A and B debentures took place at the company's offices on January 24th last in the presence of Mr. W. W. Venn, jun., notary, when debentures amounting to £11,200 were drawn, and have since been paid off at par.

The shareholders are aware that since the last meeting great changes have taken place in the Government of Brazil

With a view to further the shareholders' interests the full report of the meeting of the shareholders in November last, containing the chairman's speech and observations of the proprietors, together with a synopsis of the company's case, were submitted to Her Majesty's Secretary of State for Foreign Affairs, with a request that the influence of the British Minister in Rio de Janeiro might be brought to bear thereon. These documents appear to have convinced the Government here that the company's case was entitled to favourable consideration, and the Foreign Office accordingly instructed Her Majesty's Minister in Rio de Janeiro to use his friendly influence on the company's behalf, and the thanks of the company are due to Lord Salisbury for the support thus afforded to British enterprise. The matter is still before the authorities in Brazil, and everything has been done that can be done to bring about a favourable reply.

The dividend warrants will be posted on May 15th, 1890.

The International Telegraph Conference will meet at Paris in May next. The company will be represented, as heretofore, by the managing director.

The retiring directors are Mr. C. W. Earle and Mr. Henry Weaver, who offer themselves for re-election.

The auditors, Mr. John Weise and Mr. John G. Griffiths, retire, and are eligible for re-election.

Wrexham and District Electric Supply Company, Limited.

THE first general meeting of this company took place at the offices, No. 12, Queen Street, Wrexham, on Saturday week. The notice convening the meeting and also a letter from Mr. Soames regretting his inability to attend owing to absence in Ireland, were read by the secretary, and an exhaustive report of the proceedings of the directors since the registration of the company, and the present arrangements for the proposed works was read and adopted unanimously, also the reports of the engineers engaged.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company. The receipts for the month of April were £3,600 as compared with £4,009 in the corresponding month of last year. The receipts for the month of January estimated at £3,150 realised £3,176.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of April were £2,089, against £1,867 in the corresponding period of last year.

The Great Northern Telegraph Company, Limited. The receipts for the month of April amounted to £21,600; 1st January—30th April, 1890, £81,800; corresponding months 1889, £84,000; do. 1888, £85,200.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month of April, 1890, were £5,275.

West India and Panama Telegraph Company, Limited. The estimated traffic receipts for the half month ended the 30th April, are £3,599, as compared with £3,402 in the corresponding period of 1889. The January receipts estimated at £6,481 realised £6,557.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (April 30).	Closing Quotation. (May 8.)	Business done during week ending May 8, 1890.	
					Highest.	Lowest.
£						
250,000	African Direct Telegraph, Ltd., 4 p. c. Deb. Regd. and to Bearer	100	98 —101	98 —101	99⅛	...
1,549,160	Anglo-American Telegraph, Limited	Stock	50 — 51	50 — 51		
2,725,420	Do. do. 6 p. c. Preferred	Stock	85 — 86	85½— 86½	86½	85½
2,725,420	Do. do. Deferred	Stock	15½— 16	15½— 16	15⅝	15½
130,000	Brazilian Submarine Telegraph, Limited	10	12¼— 12⅜	12¼— 12⅜	12⅜	12¼
99,000	Do. do. 5 p. c. Bonds...	100	101 —103	101 —103		
75,000	Do. do. 5 p. c. 2nd Series, repayable June, 1906	100	105 —108	105 —108		
63,416	Brush Electric Engineering Ordinary, Nos. 1 to 63,416... ...	3	2¼— 2½	2¼— 2½	2 7/16	2 3/16
63,416	Do. do. Preference, Nos. 1 to 63,416 ...	2	1⅝— 1⅞	1⅝— 1⅞	1⅞	...
224,850	Consolidated Telephone Construction and Maintenance, Ltd. ...	14/-	9/16— 11/16	9/16— 11/16	⅝	...
20,000	Crompton & Co., Limited, 7 p. c. Pref. Shares, Nos. 1 to 20,000	Stock	5¼— 5⅝	5¼— 5⅝		
16,900	Cuba Telegraph, Limited	10	11 — 11½	11 — 11½		
6,000	Do. do. 10 p. c. Preference	10	17½— 18½	17½— 18½	17⅞	17½
12,931	Direct Spanish Telegraph, Limited ... (£4 only paid)	5	3¾— 4¼	3¾— 4¼		
6,090	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10		
60,710	Direct United States Cable, Limited, 1877	20	10½— 10⅝	10½— 10⅝	10⅝	10½
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14½— 14⅝	13⅝— 14½	14⅝	13⅝
70,000	Do. 6 p. c. Preference	10	14¾— 15¼	14¾— 15½	15⅝	14⅞
200,000	Do. 5 p. c. Debs. (1877 issue), repay. Aug., 1899	100	106 —109	107 —110		
1,200,000	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 —108	107 —110 xd	109	107½
250,000	Eastern Extension, Australasia and China Telegraph, Limited	10	14½— 14⅝	14 — 14½	14 5/16	14
320,000	Do. 6 p. c. Debentures, repay. February, 1891	100	100 —102	100 —102		
446,100	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. ...	100	103 —106	103 —106	106	...
12,500	Do. 5 p. c. Debentures, 1890, redeem. ann. drawings ...	100	100 —102	97 —100 xd		
367,900	Eastern and South African Tel., Ltd., 5 p. c. Mort. Deb., 1900...	100	102 —105	102 —105	104½	104
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	4⅜— 5½	4⅜— 5½		
46,700	Elmore's Patent Copper Depositing, Ltd., Nos. 23,001 to 70,000	2	5½— 5⅝	5 — 5½	5 1/16	5 3/16
19,700	Fowler-Waring Cables, Nos. 301 to 20,000 ...(£3 only paid)	5	2½— 2⅝	2½— 2⅝		
180,227	Globe Telegraph and Trust, Limited	10	8⅞— 9⅛	8⅞— 9	9	8⅞
180,042	Do. do. 6 p. c. Preference	10	14⅞— 15⅛	14⅞— 15	15⅛	15
150,000	Great Northern Tel. Company of Copenhagen	10	15½— 16 xd	15½— 16 xd	15⅝	15⅜
40,000	Do. do. 5 p. c. Debs. (issue of 1881) ...	100	102 —105	102 —105		
250,000	Do. do. do. (issue of 1883) ...	100	104 —107	104 —107		
9,334	Greenwood and Batley, Ltd., Ordinary, Nos. 4,667 to 14,000 ...	10	12 — 13	12½— 13½		
5,334	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	11 — 12	11 — 12		
41,600	India-Rubber, Gutta-Percha and Telegraph Works, Limited ...	10	18 — 19	18 — 19	18 9/16	18¼
200,000	Do. do. 4½ p. c. Deb., 1896...	100	103 —105	103 —105		
17,000	Indo-European Telegraph, Limited...	25	38 — 40 xd	38 — 40 xd	40	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7		
100,000	Do. do. do. 6 p. c. Debentures	100	107 —110	107 —110		
49,900	*Metropolitan Electric Supply, Limited, Nos. 6,101 to 50,000 ...	10	5½— 6	5½— 5⅝	5⅝	...
386,875	National Telephone, Limited, Nos. 1 to 386,875	5	5⅞— 6⅛	5⅝— 5⅞	5 1/16	5 1/16
49,825	Do. New Nos. 386,876 to 436,700	5	4½— 5	5¼— 6	5⅝	...
15,000	Do. 6 p. c. Cum. 1st Preference	10	12½— 12⅝	12½— 12⅝	12⅝	12½
15,000	Do. 6 p. c. Cum. 2nd Preference (£8 only paid)	10	10 — 11	10 — 11	10⅝	10 9/16
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11/- only paid)	1	¼— ⅜xd	¼— ⅜xd		
9,000	Reuter's, Limited	8	7½— 8 xd	7½— 8 xd	8	7½
209,750	South of England Telephone, Ltd., Ordinary, Nos. 1 to 2,000, 2,501 to 3,500, 93,251 to 300,000	1	¼— ⅜	¼— ⅜		
20,000	Do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 (£3½ only paid)	5	3½— 3¾	3½— 3¾		
3,381	Submarine Cables Trust	Cert.	110 —115	110 —115		
78,949	Swan United Electric Light, Limited ... (£3½ only paid)	5	4½— 4¾xd	4½— 5	5⅛	4 13/16
37,350	Telegraph Construction and Maintenance, Limited	12	44 — 46	44 — 46	45½	44½
150,000	Do. do. do. 5 p. c. Bonds, red. 1894	100	101 — 104	101 —104		
55,000	United River Plate Telephone, Limited	5	4½— 5	4½— 5	4 13/16	4¾
146,000	Do. do. 5 p. c. Debenture Stock... ...	Stock	90 — 94	90 — 94		
100,000	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...		
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	9½— 10½	9 — 10		
300,000	Do. do. do. 5 p. c. Debentures	100	99 —102	99 —102	100¼	
30,000	West Coast of America Telegraph, Limited	10	8 — 9	6½— 7½	7⅛	6½
150,000	Do. do. do. 8 p. c. Debs, repay. 1902 ...	100	121 —126	117 —122	120	118½
64,572	Western and Brazilian Telegraph, Limited	15	10½— 11	10½— 11	10⅝	10⅜
26,986	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7	6⅞	6⅝
26,986	Do. do. do. 5 p. c. Deferred	7½	4½— 4⅝	4 — 4½		
200,000	Do. do. do. 6 p. c. Debentures "A," 1910...	100	106 —109	106 —109		
250,000	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	104 —107	104 —107		
88,321	West India and Panama Telegraph, Limited	10	2⅜— 2⅞	2⅜— 2⅝	2 9/16	2⅜
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11½— 12	11½— 12	11⅞	11½
4,669	Do. do. do. 6 p. c. 2nd Preference ...	10	14 — 15	14 — 15		
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mort (Building) Bonds	$1,000	122 —126	120 —125 xd		
179,300	Do. do. 6 p. c. Sterling Bonds	100	99 —101	99 —101		
42,853	*Westmstr. Elec. Sup. Corp., Ord., Nos. 101 to 42,953 (£2 only paid)	5	1½ — 2	1½— 2		

* Subject to Founders Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 6¾—7¼.—Electric Construction Corporation (£10 paid), 9¾—10¼.—House-to-House Company (£5 paid), 5—5¼.—London Electric Supply Corporation, Ordinary (£5 paid), 2⅜—2¾.—Manchester Edison and Swan Company, £9, (£1 paid), 11/- —12/-.

BANK RATE OF DISCOUNT.—3 per cent. (17th April, 1890).

EDINBURGH EXHIBITION.

As briefly announced in our last issue, this exhibition opened on May 1st with every prospect of a most popular and successful career. It is not till this preliminary ceremony is over that one gets a fair opportunity of forming an opinion as to the nature and scope of such an undertaking as a whole, and the relative importance of the exhibits. In our former reference to the origin of the movement we omitted to give the prominence which it deserves to the name of Mr. A. R. Bennett, electrician to the National Telephone Company at Edinburgh, to whom the idea first occurred of attempting by means of an exhibition to illustrate the progress of electricity in England and the United States, and at the same time the backward state comparatively of the science in Scotland. Although many other considerations have gradually led to the scheme being enlarged, still the central and most prominent position is occupied by electrical exhibits, and they are destined, we think, to be, more than in the case of any former exhibition, the centre of general interest and attention. In the matter of appearance the buildings cannot be said to be very imposing or ornamental from any point of view, and their position gives to them an unpleasant half-buried appearance. As compared with the last Edinburgh Exhibition particularly, the present one is very scattered—the distance to be walked from the east end of the building to the end of the Machinery Hall at the western extremity cannot be less than half a mile. Any impressiveness the buildings may possess externally is solely due to the extent of ground over which they spread. At the same time, a fairly successful effort has been made to produce an imposing front or ceremonial entrance. In designing this, the architect has followed the style of the French Renaissance, embellished by an infusion of Eastern architecture. The façade is composed of two towers, 120 feet high, between which is the main entrance, surmounted by a large glazed screen, above which stands out a beautifully modelled statue representative of Electricity, supported upon the prow of a boat. Entering the grand doorway beneath this statue, the visitor is in the middle portion of the main building, which extends from front to back, a distance of 280 feet, and forms with its arched roof the most elevated part of the erection. The larger portion of this middle building is divided off by a handsome triple-arched screen, and forms a grand concert hall, with chairs for 3,000 people, having at one end an organ (by Eustace Ingram, of London), and platform for choir and orchestra to the number of 500. On the east of this middle building is the Foreign Section, and on the west are the courts devoted to British industries. The Sculpture and Art Galleries are entered from the end of the British Section, and adjoining these there is a building, variously described as the Eastern Annexe and North Court, for general exhibits, and more particularly for art furniture and its manufacture.

The portion of the Exhibition so far alluded to stands on ground which is divided from the rest of the enclosed land by the North British Suburban Railway, which is in cutting. Across the railway has been erected a level covered bridge, by which access is got to the Machinery Hall, and through it to most of the outdoor attractions, including the telpher line and the electric railway. The Machinery and Electrical Hall, which is probably destined to be the greatest attraction to the visitor, is the most striking structural feature of the Exhibition, and is one of the most convenient erections ever built for the display of machinery in motion. Though smaller in area than the one at Glasgow in 1888, it is superior in many respects to that building. The Glasgow Hall, which was square, had an area of 176,400 square feet, while the present one at Edinburgh is only 105,000 square feet; but the Glasgow Hall was inconveniently crowded, the roof was low, and the public passages narrow and ill-arranged. Here, on the contrary, the hall is of better shape, its length being 700 feet, with a central span 80 feet wide, and a clear height of 43 feet. On each side of this there is a 20-feet wide span, outside which there is a series of bays or gables 15 feet wide, the total width being thus 150 feet. The 20-feet spans cover the gangways for the public, which make a convenient and roomy promenade. The view from end to end of this hall is very fine, the roof showing most graceful lines, which fortunately have not been interfered with by any tall stands or trophies. The display of electrical machinery and appliances in this excellent building is believed to be the most valuable and most representative collection of electrical appliances that has ever been brought together. At any rate here will be found illustrations of all the most recent applications of electricity to signalling, lighting, driving and heating. A shed is annexed to the machinery hall for a range of five boilers, and adjoining this is another annexe, called the Railway Court, in which is a most interesting historical display of locomotive and kindred exhibits. The engines and rolling stock include a model of Stephenson's "Rocket," resting upon a section of the old permanent way of the Liverpool and Manchester Railway—stone sleepers and cast-iron rails and chairs; a complete train of the Old Stockton and Darlington Company, comprising an engine and tender, a waggon, and a passenger carriage, placed upon a similar permanent way; an engine by Trevethick, supposed to have been constructed in 1805, and made of cast-iron; and the carriage in which the Duke of Wellington, when Warden of the Cinque Ports, travelled on the South Eastern Railway. The modern examples include specimens of the engines run between Edinburgh and London on the West and the East Coast route. The Great Western Railway Company exhibits the "Lord of the Isles," an immense broad-guage engine, built in 1851, and shown at the Great Exhibition of that year, since which time it has run a million of miles.

Mr. A. R. Bennett, to whom we have already referred as the originator of the Exhibition, has rendered good service as convener of the electrical and lighting committee, upon whom devolved the responsibility of arranging and carrying out the details of the general electric lighting of the exhibition. The original idea was to have, in the lighting of the building and and grounds, illustrations of as many different systems as possible; but considerations of cost, and the imperative necessity of economy, led ultimately to the bulk of the work falling into the hands of two contracting firms who possessed special facilities for the undertaking. After advertising for tenders, and after due consideration, the work was divided into two portions, the arc lighting being entrusted to the Brush Electrical Engineering Company, and the incandescent lighting to Messrs. King, Brown & Co., of Edinburgh. The latter firm lights the concert hall, the reception rooms, and some of the refreshment rooms and bars, using the Sunbeam lamp, which made its first appearance at the Newcastle Exhibition in 1887. The buildings for that exhibition were put together in a similar manner to those at Edinburgh, and the use of these lamps still more tends to remind one of that successful undertaking. The Sunbeam lamp is an excellent exhibition lamp, and has deservedly come very much into favour as a competitor with the smaller arc lamps. In the concert hall there are 81 of these lamps, each of 200 C.P., and in the refreshment and reception rooms 30. Each lamp is provided with a separate fusible cut-out, the fuzes being, for convenience, clustered at convenient positions on the walls, from which the separate wires run to each lamp. The lamps are on four circuits, so distributed, that no two adjacent spans are on the same circuit. To supply these four circuits there are as many dynamos of King, Brown & Co.'s make, while a fifth machine is held in reserve. The motive-power for driving these consists of a Westinghouse engine of 100 H.P., which drives four dynamos, and a Robey engine of 25 H.P. nominal to drive the fifth. The Robey engine is constructed with automatic valve gear of the slot-link die and radius-rod type, controlled by a Richardson patent spring governor, the cut-off valve of the high-pressure cylinder forming an automatic expansion gear, by which the cut-off can

be regulated from one-eighth to five-eighths of the stroke with very little variation in speed. The cylinders are 9½ inches and 16½ inches in diameter, with an 18 inch stroke, and the number of revolutions per minute 143. The crankshaft of this engine has an outer bearing. Messrs. King, Brown & Co. employed Westinghouse engines at the Glasgow Exhibition, and, we believe, found them in every way suitable for dynamo driving. These engines occupy little space, require scarcely any foundations, and are handy for transport. It is claimed that while they are neither better nor worse than other automatic first-class engines of the same capacity, as far as the use of steam alone is concerned, in the matter of commercial economy involving the items of fuel, oil, attendance, repairs, &c., they are superior to others, the idea of commercial economy being in fact the principle which is responsible for the existence of the Westinghouse engine.

Messrs. Alley and Maclellan, the makers of these engines, are introducing a new high-speed triple expansion engine, which they call the Sentinel, and have one of 150 H.P. in the Exhibition, alongside the one last mentioned. The Sentinel high-speed triple expansion automatic engine is a combination of two improvements in the steam engine—namely, the Westinghouse automatic governor and the Hide Wardrop cylinders and valve. The object of the governor is to insure perfect control of the steam admission valve, and the arrangement of the cylinders and valves to insure perfect expansion of the steam, and the vacuum is utilised to increase the power. The combination is said to result in the greatest possible economy in the consumption of fuel, absolute regularity of speed under a varying load, and moderate cost. The most economical pressure for these triple expansion engines is 140 to 150 lbs. per square inch.

With the exception we have named, and some isolated installations which will be described separately, the general lighting of the building and grounds is undertaken by the Brush Electrical Engineering Company, their installation comprising about 365 Brush arc lamps supplied from thirteen 35-light machines, and two 15-lighters. The lamps, are of 2,000 C.P., taking 10 amperes and 50 volts, those in the buildings being so arranged that each of every three adjacent lamps is on a separate circuit, so that even if two circuits failed every third lamp would still afford a sufficient light. In the grounds there are 82 similar lamps, about half of which are arranged in groups of three on a sort of cage raised on 15 masts, some 60 feet and others 80 feet high. These iron masts are of a special construction, and contain, inside, all the conducting wires, and also the gear for raising and lowering the frame-work on which the lamps are fastened. The remainder of the lamps in the grounds are suspended from ornamental iron brackets fixed on wooden poles 25 feet high.

Of the dynamos, two groups of six are driven off separate lengths of counter-shafting, operated respectively by two Robey engines, the other three being driven when required by three independent engines without counter-shafting. The Robey engines are the most prominent feature in the display of machinery, the two largest being objects of great interest to the bystanders. The principal one is an 80 H.P. nominal compound horizontal fixed engine, fitted with Richardson and Rowland's automatic trip expansion gear for securing the utmost economy in steam and regularity of running. The cylinders, which are steam-jacketted, are 18¼-inch and 30-inch diameter with a 40-inch stroke. The engine works at 65 revolutions per minute, and the power is transmitted from a fly-wheel 15 feet in diameter by eight ropes of 1¾-inch diameter. The working steam pressure is 100 lbs. to the square inch, and the maximum indicated horse-power is 320. The receiver through which the steam passes from high pressure to low pressure is superheated by a current of high pressure steam from the boiler circulating through a coil of piping. This engine drives six Brush dynamos.

The next engine in order of size is a 65 H.P. nominal compound horizontal engine, the cylinders of which are 15-inch and 26-inch diameter, steam-jacketted, and the stroke 28-inch. The high-pressure cylinder is fitted with the trip expansion gear. It makes 86 revolutions per minute, the fly-wheel is 12 feet in diameter, and the power is transmitted by 1¼-inch ropes. The working pressure is 100 lbs., and the engine, which is capable of working up to 260 H.P., also drives six Brush machines.

The third engine employed in the Brush department is a high-speed compound horizontal engine, working up to 28 H.P., cylinders 5½-inch and 9-inch diameter and stroke 6-inch, the driving-wheel being 3 feet 6 inches in diameter by 8 inches wide. This engine runs at 300 revolutions per minute, and drives direct a 15-light Brush dynamo. Next in order are two 8 H.P. (nominal) vertical engines coupled, with the driving-wheel, 7 feet in diameter, between them. The cylinders are 9½ inches diameter, stroke 12 inches, revolutions 135 per minute. This engine is capable of working up to 32 H.P. In addition, there is another high-speed engine of the vertical type, capable of working up to 44 H.P. The cylinder is 10½ inches, stroke 10 inches, revolutions per minute 285, fly-wheel 4 feet 6 inches by 9 inches broad. This engine is very compact, and specially suitable for ship use or in any circumstances where great power is required from an engine occupying little space. It can work under high steam pressure and at various speeds. The whole of the dynamos and engines employed in lighting the Exhibition and grounds are concentrated in the middle of the Machinery Hall, occupying a space measuring 120 feet by 80 feet, which is neatly enclosed by a waist-high ornamental fencing.

The boiler house is adjacent and contains an open dial battery of 5 Lancashire boilers made by Messrs. Galloway, of Manchester, of a combined capacity of 2,500 horse-power. From these boilers practically the whole of the steam required for driving purposes is supplied, at a pressure of 110 lbs. per sq. inch. The shafting used in transmitting the power to the different parts of the Hall is entirely of steel. That in the Dynamo Court is 4½ inches in diameter, the lengths being coupled with adjustable loose collars, and it makes 230 revolutions per minute. In the Machinery Hall proper there are two distinct lines of shafting, each 3 inches in diameter, carried on Lancaster and Tonge patent adjustable pedestals. The normal speed of this shafting is 180 revolutions per minute. The arc lights dynamos are driven from a countershaft on which there are 13 steel pulleys constructed on a somewhat new principle by Messrs. Thomlinson and Walker. All the steam traps used at the Exhibition are the "Lancaster" patent high pressure, manufactured by Messrs. Lancaster and Tonge, of Manchester.

A Note of Discord.—This is how the promoters of the Edinburgh Exhibition designate the action of the Electrical Section of the London Chamber of Commerce in advising the electrical trades to refrain from participating in the exhibition till the Executive Council complied with certain stringent conditions, drawn up by a special committee, and submitted to the section on the 11th of November last. The effect of this action is believed to have acted detrimentally, at any rate, for a time, as it induced timid exhibitors who were in doubt whether the leading electrical firms intended to "boycott" the exhibition, to refrain from applying for space. However, it cannot be denied that the action of the Electrical Section of the London Chamber of Commerce resulted favourably to the exhibitor, and secured concessions which are likely to become precedents for all future exhibitions. The arrangement which resulted from the negotiations referred to is that no rent is charged to an exhibitor unless the working of the exhibition results in a deficiency. A deposit of 2s. 6d. per foot. is taken, but is returned in full at the close of the exhibition, if there is a surplus. In case of there being a deficiency, a proportional levy is made upon the amount of the deposit. As a regulation tending to a proper distribution of profits, and to reducing the outlay of exhibitors, it is worthy of being applied in all similar undertakings.

The Telephone at the Exhibition.—On the occasion of the opening ceremony the Duke and Duchess of Edinburgh were invited to listen to a musical performance at Glasgow by means of the telephone. The distinguished guests seemed very pleased with the proposal, and both held the receivers to their ears, while an instrumental band in Glasgow played the National Anthem, the loudness and distinctness of the music eliciting expressions of surprise and pleasure. It had also been intended to telephone an address to their Royal Highnesses, but as time pressed they were spared that infliction. The same afternoon a favoured few, at Glasgow, were afforded a similar exhibition of long-distance telephony. By a special arrangement the band stand at the Edinburgh Exhibition was put in telephonic connection with the exchange in Glasgow, enabling the subscribers there to hear, with the utmost distinctness, the magnificent band of the Coldstream Guards playing 50 miles off.

Where are the Edison Exhibits! This is a question that will be asked by many a visitor to the Edinburgh Exhibition who read in the journals the announcement made some time ago that the promoters of the Exhibition had arranged for the transfer to Edinburgh of the principal portion of the exhibit shown in Mr. Edison's name at Paris last year. We regret, however, to hear that the promise of Mr. Edison that this should be done has not been fulfilled, and that, for reasons unexplained, the articles have been sent elsewhere. Col. Gouraud was in attendance with the phonograph and very anxious to display the wonders of the instrument to the illustrious visitors at the opening ceremony of the exhibition, but a trifling incident prevented the realisation of his hopes, and no doubt reminded him of the parable of the ten virgins.

ELECTRIC TRACTION DATA.*

By A. RECKENZAUN.

Of the various questions connected with electric traction, the branch to which I have the honour of calling your attention to-night, appears to me fundamental to a complete knowledge of the subject. It relates mainly to tractive force and mechanical resistances on tramways. It is a subject which is not as fully appreciated by electrical engineers as it should be, although it forms the very basis of street locomotion, and I venture to say that future improvements in the economy of electric traction will in a large measure depend upon minute attention to details relating to this branch of the science. The very existence of tramways as substitutes for the common road, is concentrated in one point, viz., the reduction of tractive resistance to a minimum.

It is a well-known fact that the traction expenses on horse tramways constitute about two-thirds of the entire working expenses, and it has long been the aim of engineers to find an economical mechanical substitute for animal power. Electricity has found great favour with tramway men in the United States, and there is every probability of similar developments in Europe at a not distant date. Improvements can only be brought about by experience, and experience must be gained in actual practice and by careful observation. These, again, can be supplemented by data obtained from those who preceded us, and it is my intention to bring, in a condensed form, such data, from which you will be able to draw your own conclusions, and which will guide you in future and progressive efforts.

In order to provide facility for traction, we must have a solid permanent way, and excellent rolling surfaces. The practical value of a good rolling surface can scarcely be over-estimated. The rails must be rigid, parallel, and fixed to solid foundations. In America, flat step rails without grooves are used, these offer less resistance to traction than grooved rails, but, as a rule, they are not so solidly laid as English rails. According to Mr. D. K. Clark, the resistance to traction on an ordinary railway may be as low as 6 lbs. per ton; but so low a resistance cannot be obtained with grooved rails which are exposed to the incidents of mud, grit, stones and dirt, and which, moreover, have frequent and sharp curves.

Mr. Henry Hughes deduced from experiments on tramways a tractive resistance of about 26 lbs. per ton; often more, occasionally less. Such high resistances as these are readily accounted for, when it is considered that the flanges of the wheels frequently take a bearing on the bottom of the grooves, or on the dirt embedded therein, at the same time that the wheels roll on the surface of the rail; for thus the wheel rolls on two different radii simultaneously, and grinding of surfaces in contact must result. It may also occur that one wheel is running on its proper bearing surface, whilst the other, belonging to the same axle, has its flange touching the bottom of the groove, when by virtue of different circumferential velocities, additional friction is introduced. Sometimes the rails are a little out of gauge. All these circumstances augment the tractive force requisite with grooved rails. The horse, if it could speak, would be a good witness, but failing his verbal evidence the dynamometer has been consulted. Better than the mechanical dynamometer, however, is the ammeter. A dead beat ammeter indicates instantly the slightest variations of tractive resistances, and I venture to say that it will be through the judicious and more frequent applications of this instrument that material improvements both in the permanent way and in the rolling stock of electric tramways will be effected.

Probably the most interesting and complete tests with horse cars were those made by M. Tresca. He proved, experimentally, that the groove in the rail was the direct cause of a large portion of the resistance to traction. An ordinary car with its four flanged wheels was propelled over the tracks of the Paris-Versailles tramway, and it was found that the average tractional resistance amounted to $\frac{1}{100}$th of the gross weight, or 22·4 lbs. per ton. Subsequently two of the flanged wheels, both on one side of the car, were removed and replaced by flangeless wheels, when the resistance, all other things remaining the same, amounted to only $\frac{1}{171}$th of the weight, or 15¼ lbs. per ton. The gross weight of car and passengers was 5·67 tons. These experiments show conclusively that at least half the power is wasted in friction between the sides of the groove and the wheel flanges.

The force required to start a tramcar and to get up speed is necessarily greater than the force required to maintain a given speed uniformly. It was found that the starting force is from four to five times that necessary for running on the level road. Curves also increase the resistance very much. In dry weather, on curves of 50 feet radius, the resistance to traction is doubled, and on those of 35 feet radius trebled; but when the rails are wet, this resistance, due to curvature, is considerably reduced. Water, plenty of water, on the rails acts as an efficient lubricant, and you will see by statements later on the general effect of wet rails. Short wheel bases, bogies, or radiating axles, render motion on curved rails easier, and flexible axle boxes are now greatly favoured, especially in the United States for the same reason.

The effect of gradients is a matter of simple calculation. It is the maximum gradient on a given line which determines the size and power of the electric motor. Allowing 22·4 lbs. tractive force per ton, we should have to exert a pull of 134·4 lbs. with a six-ton car on a level road. This, at the rate of seven miles an hour, or 616 feet per minute, would give us 2·5 horse-power effective on the axles. If we have to overcome a gradient of 1 per cent., or 1 foot in 100, the resistance due to gravity will also be 22·4 lbs. per ton, therefore we shall require about 5 horse-power to pull this car up a gradient of 1 in 100. With a 2 per cent. rise the power will be three times as great as on the level, and, roughly speaking, each per cent. of grade demands as much energy as the propulsion of a given weight on a horizontal road if the speed is to be constant. On steep gradients, however, it is customary to run slower, whereby some of the energy is saved at the expense of time.

The time at our disposal will not permit of descriptions of particular systems of electric traction, nor of the relative merits of each, and we shall confine ourselves entirely to statistics on tractive force, no matter how this force is transmitted; and we shall merely consider the question of moving a given load on a given track by means of the electric current. In order to ascertain the amount of energy used on electric cars I have made, in conjunction with the Electric Car Company of America, a long series of systematic tests both on an experimental track built for this purpose, as also on the public roads under all sorts of conditions of traffic. Whilst on the experimental track we could run at any speed we liked, and without stoppages; on the public streets we were confined to the speed of horse cars in front and behind us, besides taking up and putting down passengers and regulating our vehicle to the general traffic of some of the busiest streets of Philadelphia.

This experimental track was laid in an irregularly shaped yard as shown on the diagram No. 1, and it was intended to represent as difficult a line as is likely to occur in actual practice. Its entire length was 1,005 feet, the ends being so joined that the cars could circulate continually. Five and a quarter journeys round this track represented a mile run. There were four curves, two of 50 feet radius, one of 33 feet and one of 100 feet. Tangent with the 33 foot curve was a gradient of 4·98 per cent. rise, which descended on the other side at the rate of 5·8 per cent., and joined the curve with a radius of 100 feet. On this track we carried out tests and recorded observations which may be counted by the hundred thousands. The following figures relate to experiments made with a car in the autumn and winter of 1887—1888. The vehicle was an ordinary 16 foot two-horse car, with two axles, one motor and a set of storage batteries. It weighed, with several men on board, 5·3 tons; its wheel base was 6 feet, and one axle only was driven by an electric motor with intermediate spur gearing.

The rails were the ordinary American flat rails, grooved only at and near the curves, which represented a large percentage of the entire track. With a set of 84 cells of a nominal capacity of 150 ampère hours, this car made 230 trips round this track, representing an aggregate of 43·8 miles with one charge of batteries. The car was only stopped and started fourteen times. The actual running time was 6¼ hours, giving an average speed of seven miles an hour. At the commencement the electromotive force of the

* Paper read on Wednesday, April 30th, before the Old Students' Association of the City and Guilds of London Institute.

cells on closed circuit was 160 volts, and at the end 145·2 volts, the average from actual measurements was 157 volts. The maximum current used on the steepest grade was 70 ampères, at starting, on the curve or grade, it rose to as much as 120 ampères. The average current consumed was 22·6 ampères, which corresponds to 141 ampère hours taken out of the battery. The current on the level road fluctuated between 18 and 25 ampères. The diagram (No. 1) representing this track has marked upon it the current rates used at the various points of the journey. It will be observed that the car ran by momentum during a considerable portion of the journey, this momentum being acquired during its downward movement upon the 5·8 per cent. gradient, the brake being only slightly applied, and the stoppages during this experiment, as I have said, were few.

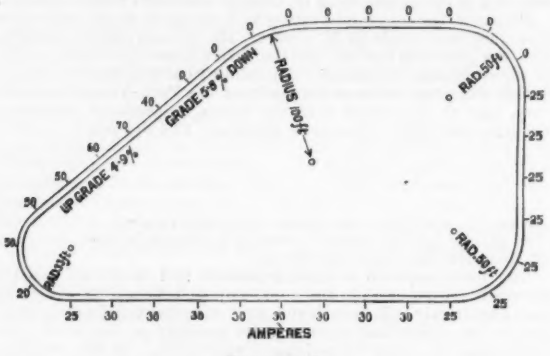


DIAGRAM 1.

A mean of 4·75 electrical horse-power was thus expended, giving a consumption of 29·69 horse-power hours supplied by the battery; and the maximum energy given off at any moment was 10,500 watts, or 14 electrical horse-power. Allowing an average efficiency of 75 per cent. in the motor, and 85 per cent. in the gearing, we obtain a total efficiency of nearly 64 per cent. between the motor terminals and the axle, or about 3 horse-power available for traction. Thus the mean tractive force throughout the 43 8 miles run was 160 lbs., or about 30 lbs. per ton. This is very low, considering that out of the entire distance we had only 21 miles of tolerably level track, the rest being made up of 3·4 miles of 33 feet curves, 7·07 miles of 50 feet curves, 3·64 miles of 100 feet curves and 4·05 miles of ascending grades of 4·98 per cent. On the other hand, there were 3·8 miles of descending grades of 5·8 per cent. which furnished momentum right along the 100-foot curve until the car passed completely into the upper 50-foot curve on the right hand side of the diagram. Converting the work into ton-miles, which is probably the most rational way of comparing figures, we get 5·3 × 43·8 = 232·14 ton-miles at an expenditure of 29·69 H.P. hours, and this gives nearly 7·78 ton-miles per H.P. hour. We have obtained much better results than this with a subsequent car containing various improvements, and, on one occasion, this larger car made 63 miles on the experimental track, each H.P. hour producing 10·9 ton-miles, but these are exceptional feats, and our present object is to consider practical results corresponding with everyday work—industrial results in fact.

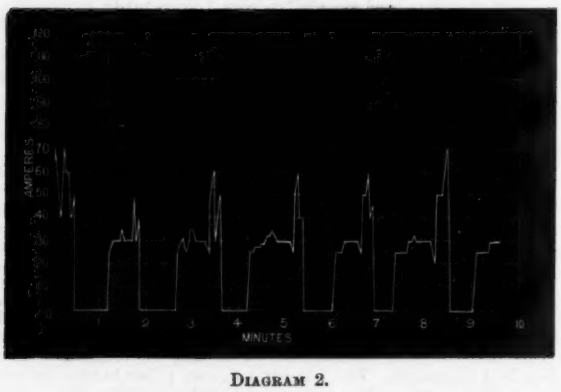


DIAGRAM 2.

Three men, each well trained for his work, were necessary for these tests, and their respective duties were as follows:—One man took charge of the switch in front of the car and the hand-brake; in fact he performed the ordinary function of a driver, taking care that the car moved at regulation speed on the level, that it did not "race" down grades, nor go too slowly up the inclines, and that it took the curves with safety. The second man, with a timepiece in his hand counted the number of round trips and recorded the same; he also took voltmeter readings at equal intervals. The third attendant had the more difficult task of reading the deflections on the ammeter and write down the values. In order to ensure uniformity in the time between each reading, and also take as many readings as possible, one has to learn to write down a certain number of figures in a given time, putting down ciphers, to fill up time when the ammeter needle is at zero. The number of observations written down during the 43 mile test were close upon 7,500, or one reading every three seconds. Considering the rapid variations in the current on uneven tracks, it is very important that readings are recorded at the shortest possible intervals in order to arrive at a correct average. The specific gravity of the cells was tested before starting, when they were fully charged, and it averaged 1,186 degrees. At the end of 6¼ hours, when the cells were practically discharged, the density fell to about 1,126 degrees. The accumulators were then recharged for 6 hours at the rate of 30 ampères when the electrolyte assumed its original specific gravity. It is impossible to keep the acid in every cell at the same density, there are always slight differences, and we had to take the mean of the entire number of cells to insure accuracy. Diagram No. 2 represents the currents used during six journeys round the experimental track, and this was virtually repeated throughout the tests, except when stopping and starting. Now compare this with diagram No. 3, showing the current variations out in the crowded streets. You will observe a number of tall narrow peaks running down to the zero line at frequent intervals. During these intervals the car was either stopping or running by momentum. The vertical lines in this diagram represent minutes and seconds, and the horizontal lines ampères measured on the car during the entire journey from 23rd street to the Exchange in Philadelphia and back to the Graysferry depôt, and from thence again to its starting point, a distance of about seven miles. Every corner on this diagram represents a movement of the switch by the driver.

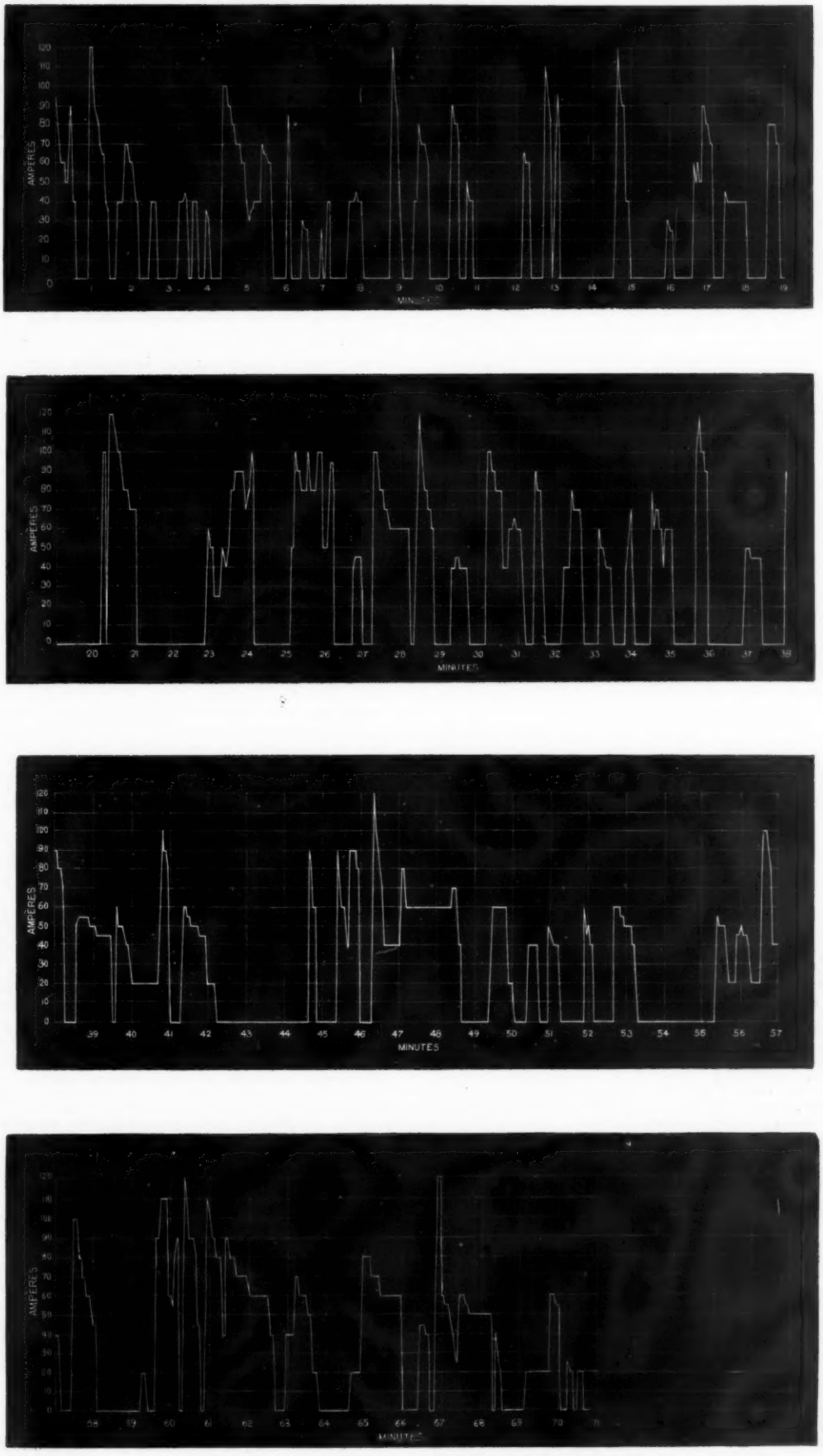
The switch was constructed to throw the various distinct coils on the field magnets of the motor into parallel or in series, or into several intermediate steps and these steps can be readily detected on the sharply defined junctions of the lines showing ampères. The average current consumed throughout this round trip, down town and back to the depôt, amounted to 31 ampères. The weather was dry, windy, and the road very dusty. Allowing for this, as well as the frequent stoppages and slowing down in order to keep pace with the horse cars on the same line, it appeared that there must have been some waste of energy. The diagram shows that there was a continuous effort of getting up great speed at one moment and slowing down the next. It shows that the driver was somewhat nervous and inexperienced to driving in the public streets, hence the frequent alternate use of high currents and brake. The gradients on this road are not very severe, the heaviest is about 4 per cent., and several of 2 and 3 per cent. Calculating as before, and allowing the same efficiency, we should get an average tractive force of 39 lbs. per ton. The car in this case carried 23 passengers one way, and 30 on the return journey, giving a mean load of 7 tons.

(To be continued.)

LOCAL AUTHORITIES AND ELECTRIC LIGHTING.

THE President of the Board of Trade, Sir Michael Hicks Beach, M.P., accompanied by Sir Thomas Blomefield, last Friday received a deputation from electric lighting companies respecting the clause in the model provisional order giving local authorities the power of absolute transfer of provisional orders under the Electric Lighting Acts.

Sir J. PULESTON, M.P., in introducing the deputation, said he did not intend to take up much time in introducing the deputation, because they had among them a well-known authority on this question in which they were interested—Mr. Fletcher Moulton—who would put their case before Sir Michael. He would say, however, that they came there to the Board of Trade because they were sure of one thing—that the Board of Trade desired to facilitate rather than to retard the progress of electric lighting; and because in so believing, they felt that after a fair consideration, the Board of Trade would come to the conclusion that the fact of the clause being inserted in the model order would inevitably retard rather than promote the spread of this new industry. He might say at once that he had no personal interest in this matter, but he was inclined to take a general interest in it since the first Parliamentary Committee of 1882, of which he was a member, and he recollected that the question of delegation was one on which they stated their views very strongly. Under this clause 60 of the model provisional order, practically the local authorities would be able to, if they felt so disposed, sit upon the provisional order, and they could practically keep it, for the great interest local authorities invariably had in gas companies would considerably influence them in the direction. Indeed, in one or two cases of which he was aware, companies had been started under favourable auspices, but the gas company, by working with the Corporation, managed to throttle the new companies in these places. He believed that if they inserted the clause in the orders, every town and every local authority in the country would apply for orders, as they would involve no responsibility whatever, and they would eventually get the orders and act, apparently in the character of middlemen or traders. The last Act of 1888 provided for the



ELECTRIC TRACTION DATA.—(The four blocks represent Diagram 3.)

longer tenure of 42 years, expressly for the benefit of private enterprises; but he considered if the powers proposed by this transfer clause were conceded to local authorities, they would be in a position to reduce the time, as originally proposed, to 21 years, by which means they would be reverting to the former conditions of things, which would oblige the companies to put on a higher price for electricity consumed by customers, and would thus impede rather than promote the success of the enterprise. They did not wish to say anything derogatory to local authorities, but they were not immaculate, and were often adverse to the immediate development of electric lighting which would prove a source of benefit to their constituents.

Mr. J. FLETCHER MOULTON, Q.C., speaking as one who had been intimately acquainted with what had been done in the matter of electric lighting, and one who had closely watched the whole of the proceedings both in Parliament and the Board of Trade, remarked that he wished very shortly to put before Sir Michael what seemed to him to have been the views of Parliament and of the Board of Trade during the development of electric lighting as to this most important question of transfer. Sir Michael would probably remember the Select Committee of 1882, before which the Electric Lighting Bill came, and the whole question of the transferring of provisional orders or licenses was considered very carefully, and he thought that the dominant feeling in the committee was that if their rights were granted by provisional orders or licenses they should not be in the nature of concessions in which traffic could take place, that the power of supplying the electric light in a district was consistent with public duty, and was not a matter which should be handed from one person to another without the direct control of Parliament. Parliament also, he believed, thought it would be by no means a right thing to draw any wide distinction between companies and local authorities, although it was the opinion that local authorities stood in a different position with regard to supplying electric light and electrical power to the companies. He remembered it was most distinctly stated by the representative of the Board of Trade, and he could certainly say it came before the whole of the committee, that local authorities, if they came forward to ask for powers to distribute electricity, their intentions must be *bona fide*—there must be no "dog-in-the-manger" policy—and he might also say, it should be their intention to immediately put it into effect. It was felt that the real question was whether the public ought to have the electric light; that the question of gas interest with the local authority was entirely a different matter, and that the public, who had the electric light given to them, should be protected even by the local authority themselves.

The PRESIDENT remarked that it was never intended that the objections of the local authority to any schemes should be overruled by the Board of Trade.

Mr. MOULTON said he did not for one moment mean to say that the views of the local authority should be disregarded, for it had always been the custom to give the greatest weight to the wishes of the local authority, but it was never intended that the local authority should necessarily stop a company from supplying the public with the benefit of the electric light; and further, it was not intended that the local authority should have powers if they did not mean to do the work.

The PRESIDENT: But if the local authority did nothing under their order in two years they could revoke it.

Mr. MOULTON, proceeding, said that in 1888 another committee was appointed by Parliament to consider the question of electric lighting, as the thing had practically broken down because the Electric Lighting Act allowed so short a period as 21 years in which the company would have to establish its works, get customers, make its profits, and provide for depreciation. Twenty-one years was too short, and the Act of 1888, dealing with this, put down 42, which he thought a very reasonable number of years, but at the same time a clause was put in giving greater statutory weight to the position of the local authority. Otherwise he thought the Act of 1882 practically remained unchanged. Now, last year he believed for the first time, at the application of one local authority, a clause was put in the order giving that local authority the power of transfer. That was, he believed, in the case of Swansea electric lighting. He did not know if that was any objection, he did not know if it was challenged, he only heard it quite recently, but the clause was put in.

The PRESIDENT: Powers have been inserted in the licenses of local authorities since 1884. Swansea was a provisional order.

Mr. MOULTON: Licenses have been the means of only a very small portion of powers being granted. They are only for seven years, and can only be applicable for some experimental attempts, and they are not suitable for a substantial public supply. Some few have, however, been applied for by local authorities, but so far as companies are concerned I do not think they have been much applied for.

The PRESIDENT: One company still holds a license, and the principle of transfer is the same.

Mr. MOULTON: That may be so. I have not considered it. But with one exception I do not remember any license of any importance in connection with companies. The question of this transfer clause being put into the orders has been before the companies, and I think the Board of Trade at the commencement of the year rather favoured its not being inserted; but there has been a discussion on the subject with the municipal authorities, and we understand it is going to be inserted in all provisional orders granted to local authorities. I will not deal with this point. I wish to show that it is unfavourable and contrary to the general Act, which overrides all provisional orders. I say that it is not within the power of a provisional order that it should be allowed to be transferred, without going to Parliament, from a local authority to a company, and I submit that it would be very detrimental to the interest of the public if this clause was inserted.

The PRESIDENT: The Act already enables the Board of Trade to sanction transfers.

Mr. MOULTON said that this was quite different to the proposed clause, for whereas one provided for the transfer of certain portions of the order, the other gave the power of bodily transferring the whole of the provisional order. Mr. Moulton then read Clause 4, which, he said, provided that no provisional order can authorise the supply of electricity unless notice has been given of such provisional order. But under the new clause it was different. The local authority might give the notice and might obtain the order. The local authority would be able to transfer the order to a company, and that provisional order would authorise that company to distribute electricity, although the company had not given any notice. If this was to be the case, a body of middlemen would be created, and they would decide not the Board of Trade, not Parliament, who were to be the undertakers. Mr. Moulton said of course the granting of a provisional order to local authorities was a step which Parliament regarded with very great favour, and the granting of an order to a company was one which Parliament looked into very carefully. He submitted that it was intended that powers for distributing electricity should not get into the hands of any company without this notice to the public, and that the provisional order was intended to mention the persons who were to be the people to have the direct supply.

The PRESIDENT: You submit that there should be no right of transfer at all?

Mr. MOULTON: You already have the right to transfer by provisional order, but this clause provides for the right of bodily transferring the provisional order.

Sir JOHN PULESTON: It should be given subject to restrictions.

The PRESIDENT: These are very considerable restrictions in this proposed clause.

Mr. MOULTON: We do not wish to get away from the Board of Trade—we have great confidence in the Board of Trade—but in a case like this we consider Parliament should be the power with whom the terms should be made.

The PRESIDENT stated that, so far as the Board of Trade were concerned, companies would get as much protection as before; but he supposed they were afraid of losing the protection of Parliament.

Mr. MOULTON said they would lose the protection of Parliament, and he also believed, in a measure, they would lose the protection of the Board of Trade. They had heard of grave abuses by municipal corporations in other countries, but he hoped they would not have them in his country; still, he submitted it was necessary to consider this. Before any such rights are entrusted to a public authority with liberality, because it was a local authority, of handing it over to a private company, he considered there should be a scouting of Parliament. Therefore he submitted that the clause not only went beyond what was meant by the Act, but it was organising a mode of dealings in concessions.

Mr. HENRY KIMBER, M.P., referring to the fact that the President had stated that they had the power of revoking an order after the elapse of two years when nothing was done under same, said that in the case of Brighton the Corporation had had the order for seven years, and had only just recently intimated the intention of undertaking the responsibilities of the order. He was quite sure that in some cases, if the public had an opportunity of coming to the Board of Trade, the position of local authorities who had obtained powers under the Electric Lighting Act would be very different.

The PRESIDENT said that the local authorities were the elected ropresentatives of the public. He did not look upon local authorities in the same light as private companies.

Mr. B. E. W. WILLIAMS said that Sir Michael would probably remember that last year he had an interview with him (Sir Michael), and he pointed out that in 1883 a great number of provisional orders were granted to corporations and also to private companies, and whereas in every case of the latter the orders had been revoked, not one of the orders of local authorities were revoked. He (Mr. Williams) pointed out the injustice of this, and, in reply, Sir Michael said that he looked upon them (local authorities) in a totally different light to supply companies.

The PRESIDENT: You are carrying my words rather further than I intended. I did not say I would not revoke any order of local authorities.

Sir JOHN PULESTON remarked that the real point was, they were desirous of promoting the science of electric lighting, and did not wish to see its progress impeded.

The PRESIDENT: I do not think it is the business of the Board of Trade to force the electric light on any town.

Sir JOHN PULESTON: No, but to facilitate it.

The PRESIDENT: Ah! the two words have very much the same meaning in this sense. If the local authority would use the powers given to them to keep the electric light out of its town, I should, of course, not allow that.

Mr. KIMBER: Then I hope you will hear anybody who could argue the facts of these cases.

The PRESIDENT: Yes, certainly.

Mr. KIMBER: Then how are they to get here?

The PRESIDENT: Simply come here.

Mr. KIMBER: But you say, sir, that you cannot have the public here.

The PRESIDENT: I say it is not within my right to interfere with the public, because they have their own electrical representatives.

Mr. MOULTON was proceeding to refer to the question of spending the ratepayers' money, when

The PRESIDENT, interrupting, said: The question of obtaining the money is another point. The argument laid before me is that the local authority won't spend more; they will do nothing directly or indirectly in electric lighting. I think that you had better submit to me, in writing, your objections to this clause. Mr. Moulton has stated them very ably, and I should like to have them before me. I should particularly like to have your views as to the question of the terms. It could be argued that it is one thing for local authorities to do the work, to establish works of their own, and then let them from time to time, but it is another thing to give over the concession for 21 years.

The deputation then thanked the President of the Board of Trade, and withdrew.

CORRESPONDENCE.

Mr. Higgins's Institute Paper.

In your issue of the 18th inst. there is an abstract of a paper read before the Institution of Electrical Engineers by Mr. Higgins on "The Diathermancy of Air in Relation to the Efficiency of Incandescent Lamps."

This contribution contains nothing that is new, nor do I see any additional reliable practical results therein, beyond what have been already published.

The results Mr. Higgins has obtained for the three lamps by using a thermopile for his purpose, could have been obtained by a practised person using his hand for the test, for such a person could have separated these three particular lamps according to their order of exhaustion.

I should be inclined to think that diffusion and convection have, in at least two cases, more to do with Mr. Higgins's results than diathermancy had.

In the same paper Mr. Higgins says he has not seen or heard of any previous mention of this property. The hand test is in itself a recognition of this property, *i.e.*, the permeability of the surrounding medium to radiant heat; the varying effects on the efficiency of lamps caused by imperfect exhaustion, have been long known to lamp makers and have been used as a rough test of the state of exhaustion.

Mr. A. Bernstein published an article in the *Centralblatt für Electrotechnik* and *Industries*, March, 1889, showing the energy per unit of surface required to maintain a dull red glow (526° C.), using platinum wires enclosed in a medium at various pressures, from 760 mm. down to the highest possible vacuum.

Also Mr. Swinburne, in his papers on Lamp Making in the ELECTRICAL REVIEW two or more years ago, pointed out that the observation of excessive warmth was an indication of bad exhaustion.

The practical use of this property as a test of the minute differences in the vacua of well and carefully-made glow lamps, does not seem to hold out promise of any reliable results, and to me it is not such a simple matter as Mr. Higgins would imply. For instance, the differences in the state of exhaustion between two carefully-made glow lamps which have been already tried by the coil test, are in any case far within the $\frac{1}{10}$th inch Mr. Higgins gives, and these differences are so minute as to be immeasureable when compared with the differences likely to have arisen in the measuring of, 1st, the surface of the filament, and 2nd, the electrical power converted therein.

The coil test can only by great care and exact observation of results be made fairly satisfactory, and one would therefore still wish for a test which would not want so many precautions and would quickly show comparative states of exhaustion, not within $\frac{1}{10}$th inch but within $\frac{1}{10}$th of a miilimeter.

With the coil test, and however performed, lamps will give a negative result both with perfect vacuums and very imperfect ones, but such lamps, if mixed together, can be at once separated by incandescing them and using the hand test.

Mr. Higgins also remarks that "lamps with a perfect vacuum attain and lose their incandescence slowly when the current is applied or removed, while those lamps having an imperfect vacuum start suddenly into incandescence, and as suddenly lose it."

Although this may be quite true of similar metallic filaments, yet, on the other hand, with carbon filaments, both these effects may be simultaneously obtained by placing two carbons in the same bulb, but one of which (carbons) varies somewhat either in density or condition of surface.

For instance, by taking two filaments, one of high specific resistance and the other of low specific resistance, and both having similar surfaces, giving the same candle-power and requiring the same number of watts per candle-power, then by simultaneously applying and removing the current to these two filaments when inclosed in the same medium, it will be seen that Mr. Higgins's statement has no practical signification, for the carbon of high specific resistance will suddenly increase in incandescence and as suddenly lose it, while the carbon of low specific resistance will slowly increase in incandescence and as slowly lose it.

C. J. Robertson, A.I.E.E.

Middelburg, Holland,
April 29th, 1890.

Electrification.

Pending a reply from some more authoritative source to the interrogatories addressed to you by "Inquirer" in your issue of May 2nd, I would crave a portion of your space for the following theory which I would proffer as an answer to the questions put:—

A.—(1). The deflection obtained after one minute with 100 cells, applied at the expiration of one minute's electrification with 50 cells, should be equal to the sum of the 1st and 2nd minute's readings with 50 cells.

(2). The deflection obtained after one minute with 150 cells, applied at the expiration of one minute's electrification with 100 cells, and after two minutes with 50 cells, should be equal to the sum of the 1st, 2nd and 3rd minute's readings with 50 cells.

(3). The deflection obtained after one minute with 200 cells, applied at the expiration of one minute's electrification with 150 cells and after two minutes with 100 cells, and three minutes with 50, should be equal to the sum of the 1st, 2nd, 3rd and 4th minute's readings with 50 cells.

B.—Starting with the self-evident proposition that the deflection is proportional to the E.M.F. employed, we will apply the 50 cells to the cable, and at the end of one minute a certain deflection is obtained, that is to say a certain rate of electrification has been observed. At the end of the second minute the electrification due to the 50 cells is still taking place, whether an additional 50 cells be added or not. If an additional 50 cells be applied at the expiration of one minute with the original 50, the deflection will be increased, because the additional battery will be doing its work separately and precisely the same as if the cable had not been previously charged. Consequently at the end of the second minute we have the deflection produced by the original 50 cells at the second minute of its application, plus the deflection due to the second 50 cells at the expiration of the first minute of its application. Theoretically this latter should be the same as the deflection with the original 50 cells at the end of the first minute, therefore the resultant reading with the two powers together and applied as stated should be equal to the sum of the deflections after the 1st and 2nd minutes with the 50 cells alone.

The potential to which the cable may be originally charged and the corresponding electrification will have no other effect on the subsequent deflections obtained with an augmented E.M.F., than to increase the deflection by an amount due to the original E.M.F. This is subtracted from the deflection obtained with the increased E.M.F., will give the proportion due to the

latter, that is to say, that even when the electrification due to the original E.M.F. is not completed, it is only necessary to subtract the deflection obtained with it, at any given time, from the total deflection subsequently obtained with it and the superposed E.M.F. together in order to arrive at the separate value of the latter.

Briefly stated, the deflections obtained from minute to minute with an increased E.M.F., are those which would be obtained, at corresponding periods, from the sums of the deflections with the original E.M.F.

X. Y. Z.

Observations on Electrification.

I am not aware of the existence of any text book which treats of the phenomena connected with electrification in a thoroughly exhaustive manner. But even without such assistance the questions put by "Inquirer" in your issue of May 2nd do not seem very difficult to answer, and with your permission I will endeavour to explain what is, at all events, a very possible theory.

A. Suppose the electrification readings on a section of cable, free from charge, when tested for insulation be as follow :—

1st min. = defl. a — 2nd min. defl. b — 3rd min. = defl. c — 4th min. = defl. d.

If, then, the same section be thoroughly discharged and tested again in the manner "Inquirer" describes—that is, commencing with 50 cells and increasing the testing battery by 50 cells exactly at the completion of each succeeding minute without breaking the continuity of the test—the following deflections should be obtained in each case :—

						Total defl. observed.
Beginning of 1st minute	...	50 cells				
1	end of 1st "	...	a	{ + 50 cells } = 100 " }	...	...	a
2	" 2nd "	...	b	a	{ + 50 cells } = 150 " }	...	$b + a$
3	" 3rd "	...	c	b	a	{ + 50 cells } = 200 " }	$c + b + a$
4	" 4 th "	...	d	c	b	a	$d + c + b + a$

The last deflection $d + c + b + a$ means that the

1st	50 cells	has been on cable during	4	minutes, giving defl.	= d
2nd	"	"	"	"	3	"	"	"	= c
3rd	"	"	"	"	2	"	"	"	= b
4th	"	"	"	"	1	"	"	"	= a

The sum of these separate deflections, therefore, represent the total deflection at the end of the fourth minute, when the total battery power applied has been increased to 200 cells by increments of 50.

B. The explanation is that each increment of E.M.F. from the moment of its application produces precisely the same effect and rate of electrification as the first 50 cells, and the resulting electrification is merely superimposed on any previous electrification produced by the smaller battery power. Thus the second 50 cells gives rise to an electrification equal to the first 50 and quite independent of it, only as the latter has a minute's start of the second 50 cells, the total deflection at the end of the second minute is the sum of the electrification in the cable attributable to the first 50 cells for two minutes (b) plus the electrification due to the second 50 cells for one minute, the latter being of course equal to the electrification of the first 50 cells at the end of the first minute (a). Therefore the deflection observed at any given minute, while increasing the E.M.F., is the combined result of the two electrifications at that interval of time. To carry the example further: if a third 50 cells be applied at the end of the second minute, it will set up an electrification in the same way as, and equal to the first 50 cells, the effect being again superimposed on the two previous electrifications, but having an independent existence. Consequently, at the end of the third minute, the total deflection observed is due to the combined electrification arising from the first 50 cells after the third minute (c), plus the electrification from the second 50 cells after its second minute (b), plus the electrification of the third increment of 50 cells after its first minute (a). The deflection due to the combined electrification from the three groups of cells will therefore equal $c + b + a$. It is then evident that the total deflections which would be obtained from further increments of 50 cells applied at similar and equal intervals, would follow the same process.

The axiom may be laid down that the potential to which the cable may be charged at the moment when the testing battery is increased, has no other effect on the electrification due to the additional E.M.F. than to increase the total deflection observed at any particular moment by an amount equal to the degree of electrification due to the original battery at that period.

I would here observe that the term "electrification" which, strictly speaking, does not include the permanent leakage but is only applicable to the "fall," is, for convenience sake, loosely applied to the total deflection derived from both phenomena.

If the 50 cells be applied to the cable for several hours, so that the electrification be completed (the permanent leakage through the insulating material being practically constant), and an additional 50 cells be then applied, we should expect, by subtracting the permanent and constant leakage due to the first 50 cells from each of the series of readings obtained from minute to minute when the second 50 cells has been applied, to get similar readings as when testing with the original 50 cells alone, since the fact of the cable being charged to a certain potential does not interfere with the electrification arising from an increased E.M.F.

This, indeed, is to be expected, for although the deflections obtained when testing a cable for insulation are, after the same interval of time, proportional to the E.M.F. applied, yet the rate of electrification is precisely the same with a higher as with a lower E.M.F.

Observer.

Voltmeters.

In reading over Prof. Perry's account of Ayrton and Perry's strip voltmeter I was not at all surprised to find that the use of a transformer in combination with a voltmeter for reading various pressures had been found by them to be a very satisfactory method of measurement It is not new, however, as I used that method, and a great many others since the publication of my patent have also been using it for years past. My patent dates from 17th March, 1887, but I used the method in my laboratory for some time in 1883.

If I may venture to express an opinion on the twisted strip voltmeter, I may say that the most *metallic* forms of carbon strip which I have come across is that which was used in Weston's Tamadine carbon lamps, it has *resiliency* in the highest degree. My opinion is that it is the strip for this voltmeter.

While on the subject of voltmeters I may remark that I have not yet come across a cheap compact form of alternating voltmeter suitable for fixing to a switchboard, or in low pressure circuits in houses, which is entirely satisfactory, there is room for improvement; perhaps this new instrument of Messrs. Ayrton and Perry may fill the bill.

Rankin Kennedy.

May 5th, 1890.